NASA-CR-205182

Final Report
NASA Grant NAGW-5017
What is Space Weather? -- A Workshop for Science Writers

C. Robert Clauer, Principal Investigator

This project sponsored the organization and hosting of a workshop for science writers to learn about the physical nature of and impact of space weather. Several of the nation's foremost space researchers who have particularly strong skills in articulating information about space weather and its potential impact on society participated in the workshop. These individuals include: Dan Baker, Howard Singer, John Kappenman, Joe Gurman, Jim Green, Janet Kozyra, Tim Killeen, Ray Roble, Lou Lanzerotti. The workshop was held in Ann Arbor on Feb. 23, 1966 and the agenda for the meeting is attached. Pat Reiff had planned to attend but was unable so her presentation was canceled and Tim Killeen made a presentation in her place. Mario Acuna was unable to attend and Jim Green attended in his place. Ray Roble attended and while he did not make a formal presentation he did participate in the question and answer periods and in the discussion.

The news and information service of the University of Michigan assisted in preparing a mailing list of the nation's major science writers and undertook the mailing of workshop information. About 50 news writers were notified about the workshop and 7 reporters attended. The attending reporters were: Jon Van from the Chicago Tribune, Madeline Nash from Time Magazine, Matt Crenson from the Dallas Morning News, Nancy Ross Flanigan an independent writer, Karl Bates from the Detroit Free Press, Dave Thomas from the American Geophysical Union, and Steve Marin from Goddard Space Flight Center. A number of other reporters contacted us regarding the workshop indicating an interest in the subject and inquiring about the possibility of receiving material from the workshop.

The workshop was characterized by short presentations followed by considerable discussion and time for questions and answers. This format seemed to work well. The late afternoon capstone to the workshop was a public lecture as part of the Space Physics Laboratory Colloquium Series, presented by Dr. Louis Lanzerotti titled "How does the Dynamic Space Environment Affect our Technologies in Space and on the Ground."

The workshop presentations and discussion as well as the Lanzerotti colloquium were video taped. The tapes were edited to include several of the best presentations. Sixty tapes were produced. A copy of the tape and other workshop materials (copies of presentations and the Guide to Space Weather Information via the WWW developed by Janet Kozyra) were distributed to workshop participants as well as others who requested more information. The availability of the tapes was advertised to the entire mailing list and about seven additional people requested to receive a copy. A copy of the tape is included in this final report. We have also compiled a list of space scientists throughout the country and in other countries who responded to us volunteering to be contact points for media questions. A copy of this list is enclosed as well and has been extensively distributed to science writers.

We know of several articles that resulted from this workshop. Articles appeared in the Dallas Morning News, the Chicago Tribune, and in Time Magazine.

Enclosures:
Workshop Agenda
Video Tape of selected workshop presentations and Lanzerotti Colloquium
List of Space Weather experts willing to interact with the media

"What is Space Weather"

A Workshop for Science Writers

Space Physics Research Laboratory

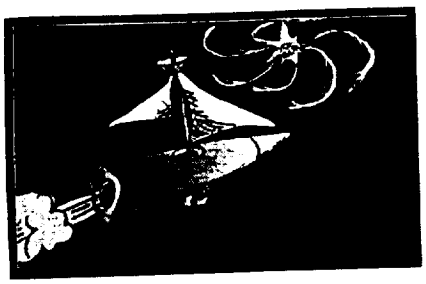
The University of Michigan

Ann Arbor, Michigan

February 23, 1996

Janet Kosyra (SPRL)

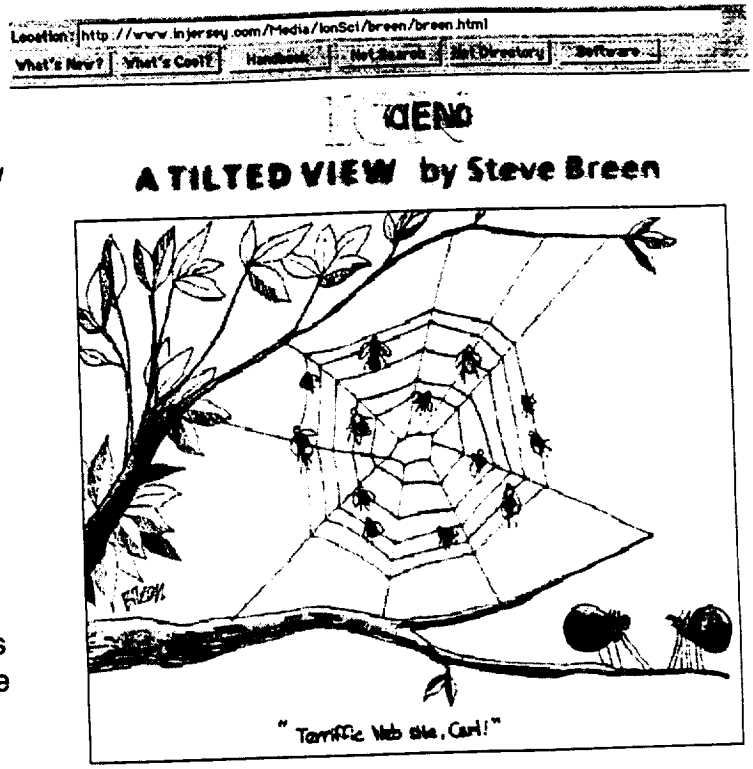
Mining Information Related to Space Weather Using the World Wide Web



Pocket Guide to Space Weather Sites on the World Wide Web

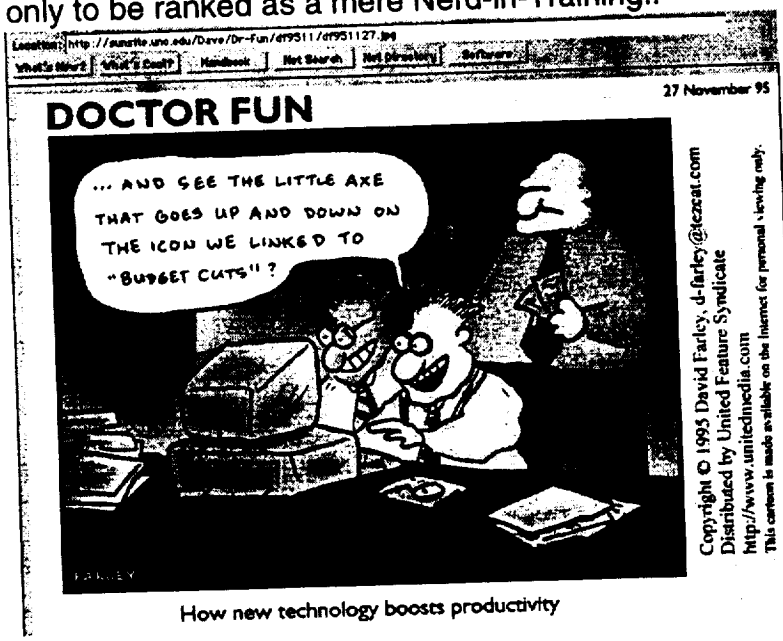
Introduction

The web is rapidly coming into its own as a vehicle for accessing the nation's vast storehouse of space science information. New planetary and earth-orbiting satellite missions all have a web presence. Many national observatories, satellites, and forecasting facilities allow access to their near-realtime data streams through web interfaces. NASA's archives of photographs and spacecraft databases are open to web users to browse.



The Purpose of this Guide

There are some fascinating sites out there, if you take the time to travel the web's highways and byways. Unfortunately, this can be a time consuming exercise with many detours along the way. During preparation of this guide in the wee hours of the morning (when web traffic is lightest), I was enticed to review the entire cartoon archives of Doctor Fun. Then expended considerable time and energy making my way through the web's Nerd test - only to be ranked as a mere Nerd-in-Training..

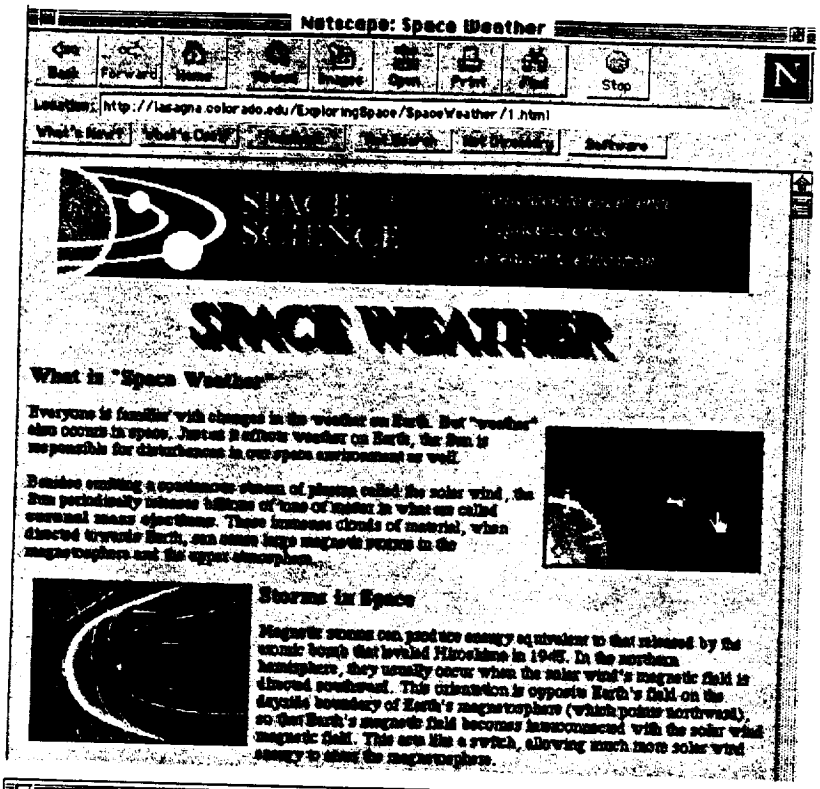


How new technology boosts productivity

It is certainly true that the main strength of the web is the variety and quantity of information it houses. To navigate in this environment, it is sometimes helpful to have a roadmap to identify interesting sites and streamline your entry. With this purpose in mind, we spent some time visiting space weather and space physics web sites all over the world to identify some of the most visually appealing and user friendly ones among them. Within this pocket guide, we try to describe the special features of these select web sites as well as to provide information on sites which contain hot links to more complete lists of space physics related sites.

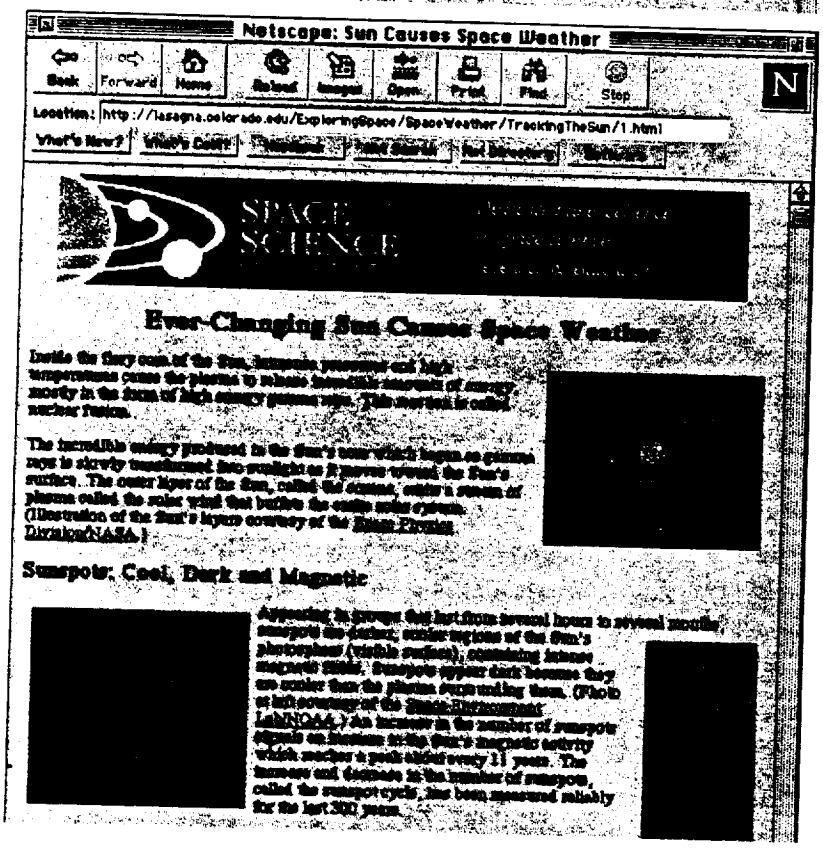
A Virtual Space Weather Library

The world wide web is a browser's paradise of on-line tours, books and multi-media exhibits related to space weather and space physics. This section contains a selection of some of the best and most complete sites.

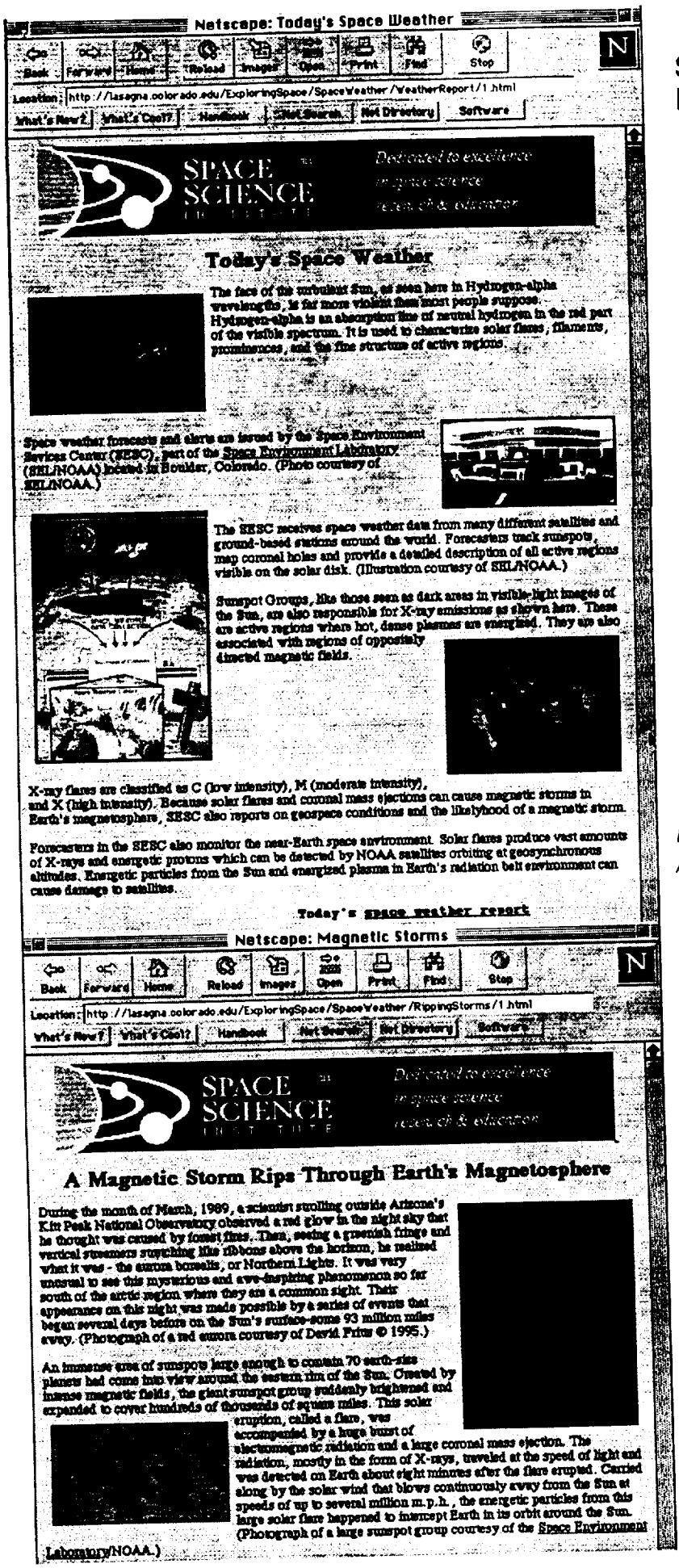


Concise and visually-appealing tours of space weather and related topics from the Space Science Institute.

http://lasagna.colorado.edu/ExploringSpace/SpaceWeather/1.html



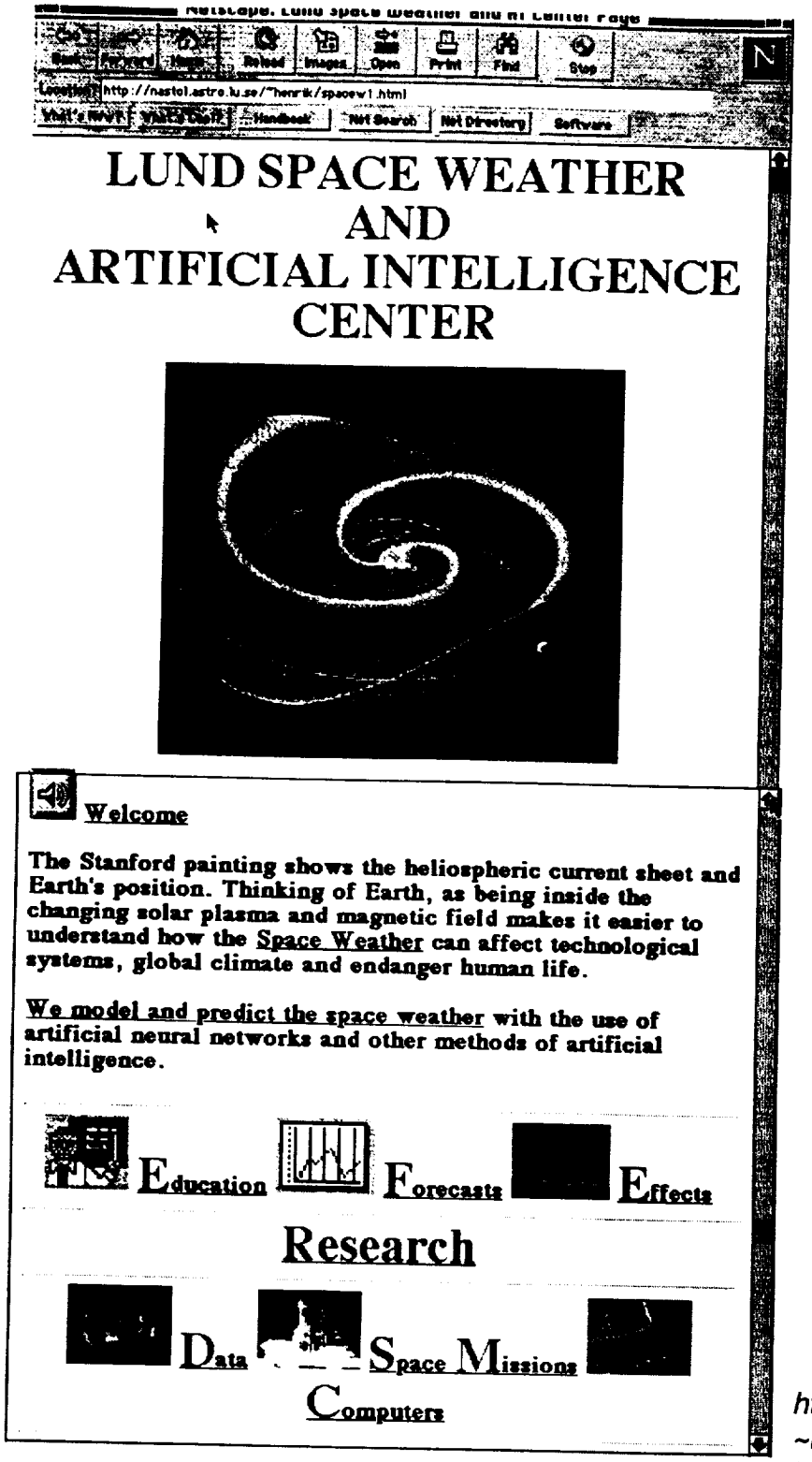
http://lasagna.colorado.edu/ExploringSpace/TrackingTheSun/1.html



Sample of other Space Science Institute web pages.

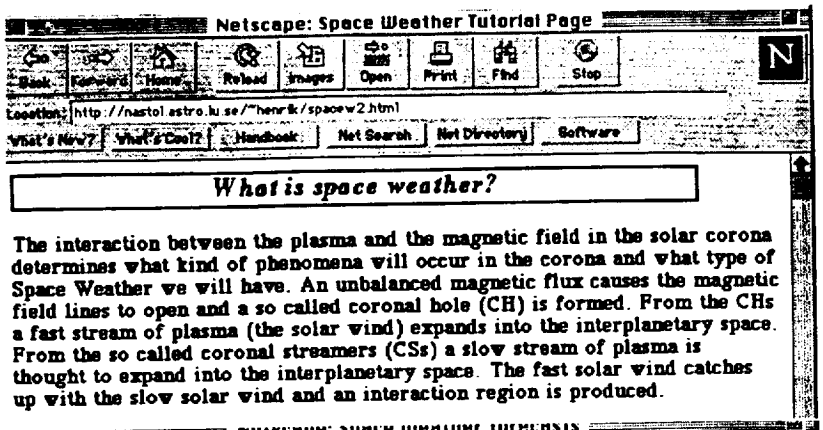
http://lasagna.colorado.edu /ExploringSpace/SpaceWeather/ WeatherReport/1.html

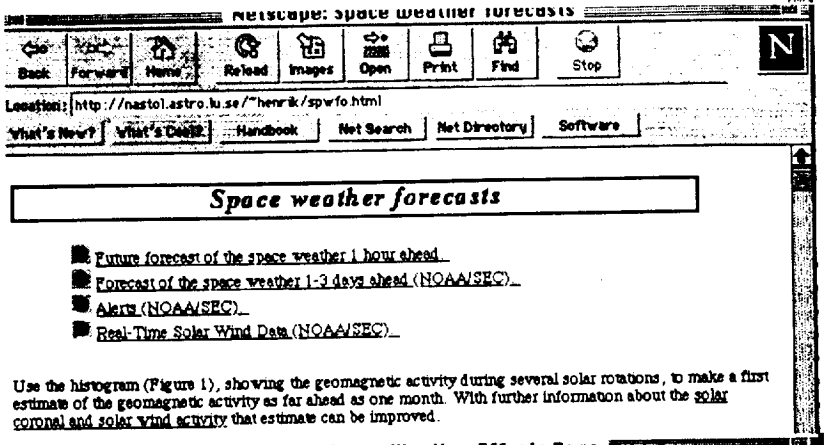
http://lasagna.colorado.edu/ ExploringSpace/SpaceWeather /RippingStorms/1.html

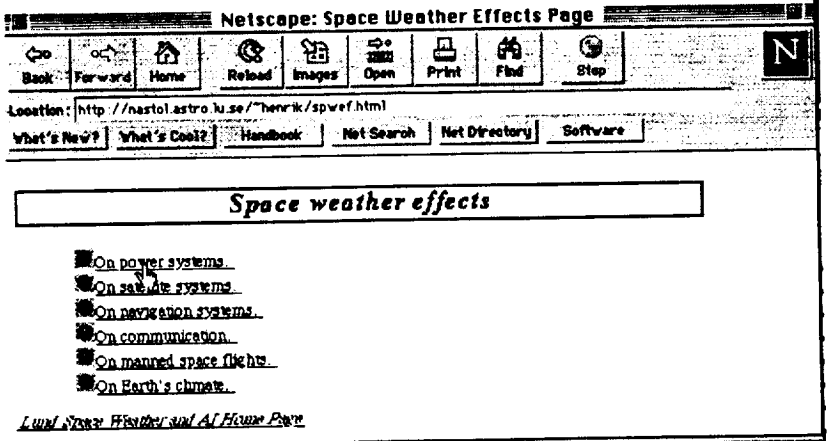


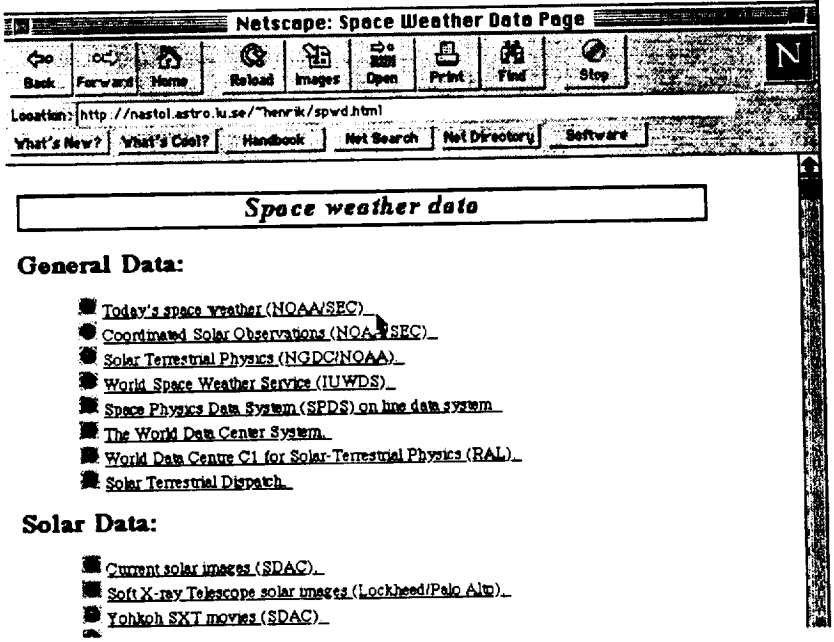
Very complete set of materials on space weather, the effects of space weather on technologies, the types of forecasts and research data sets including a listing of current and future space missions that are expected to provide important information.

http://nastol.astro.lu.se/~henrik/spacew1.html









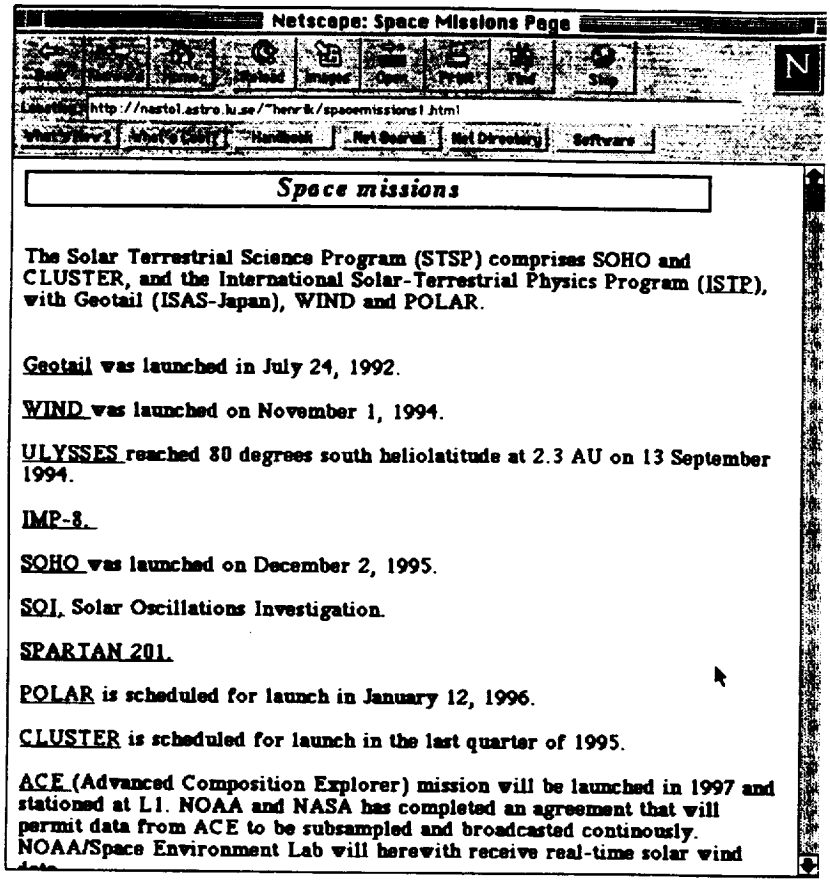
Samplings of topics covered in the virtual library at the Lund Space Weather Site

http://nastol.astro.lu.se /~henrik/spacew2.html

http://nastol.astro.lu.se /~henrik/spwfo.html

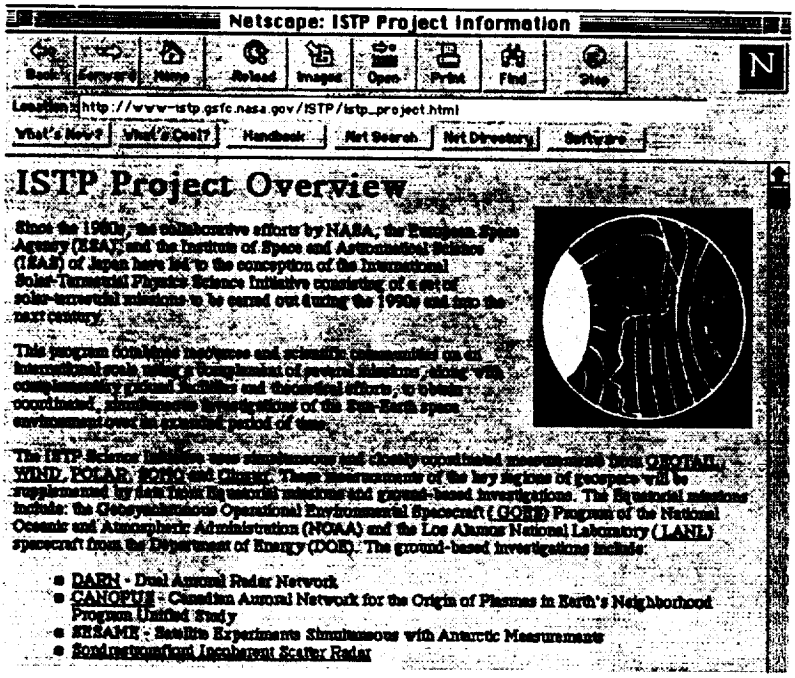
http://nastol.astro.lu.se /~henrik/spwef.html

http://nastol.astro.lu.se /~henrik/spwd.html

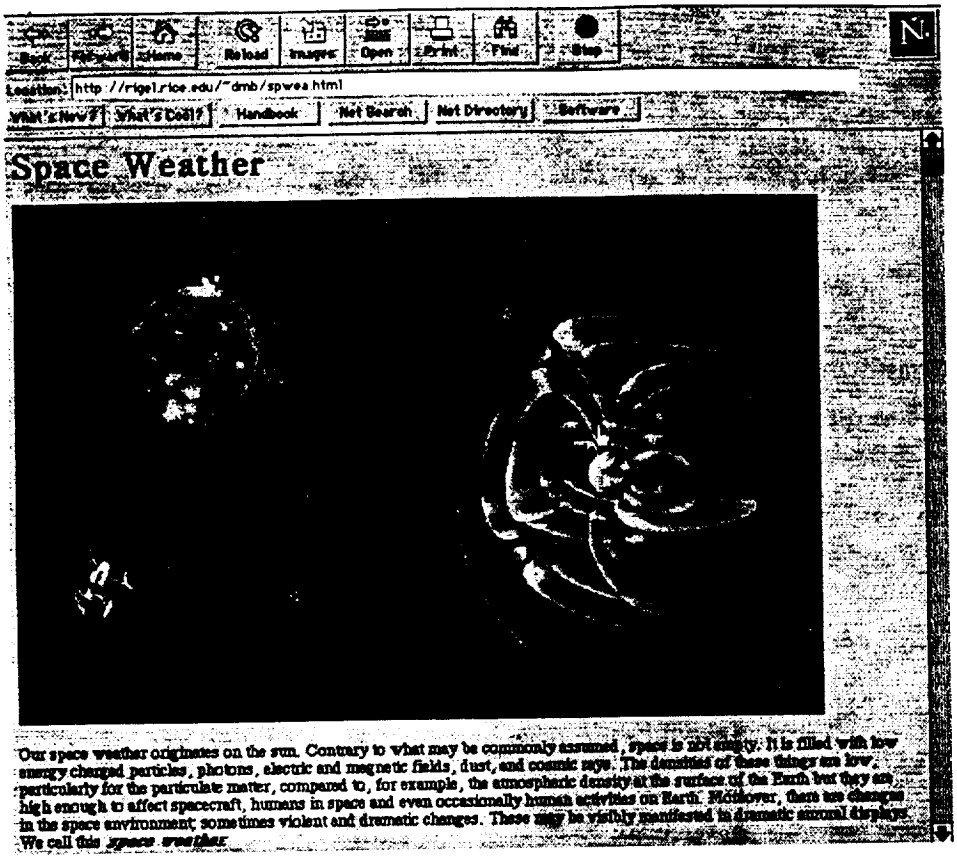


A selection of space missions relevant to space weather forecasting and research

http://nastol.astro.lu.se/ ~henrik/spacemissions1.html

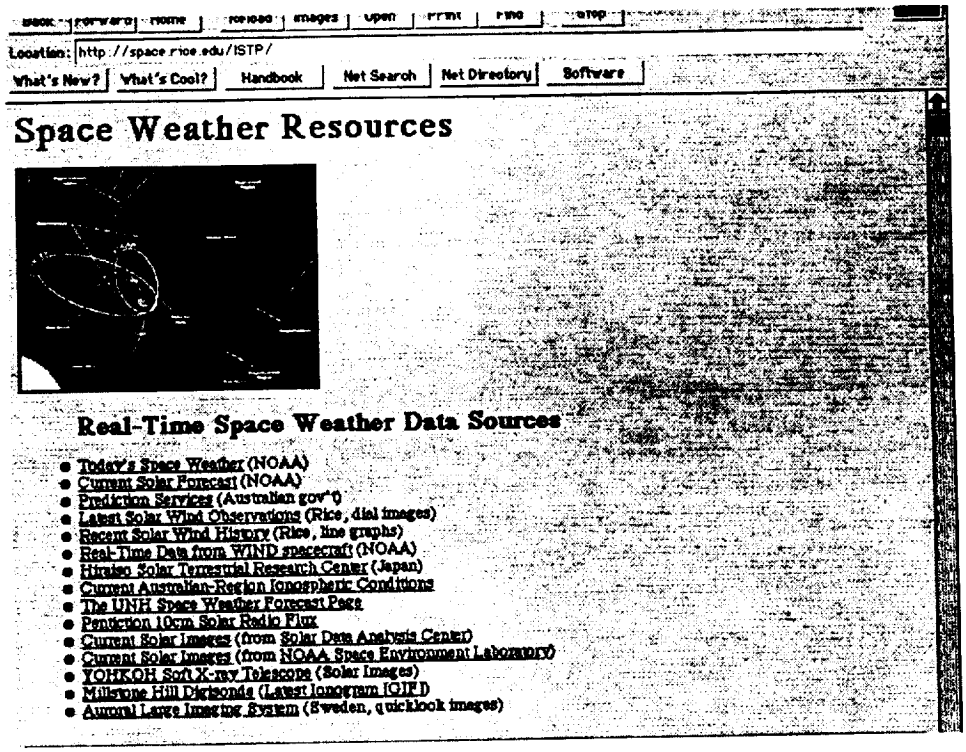


http://www-istp.gsfc.nasa.gov /ISTP/istp_project.html



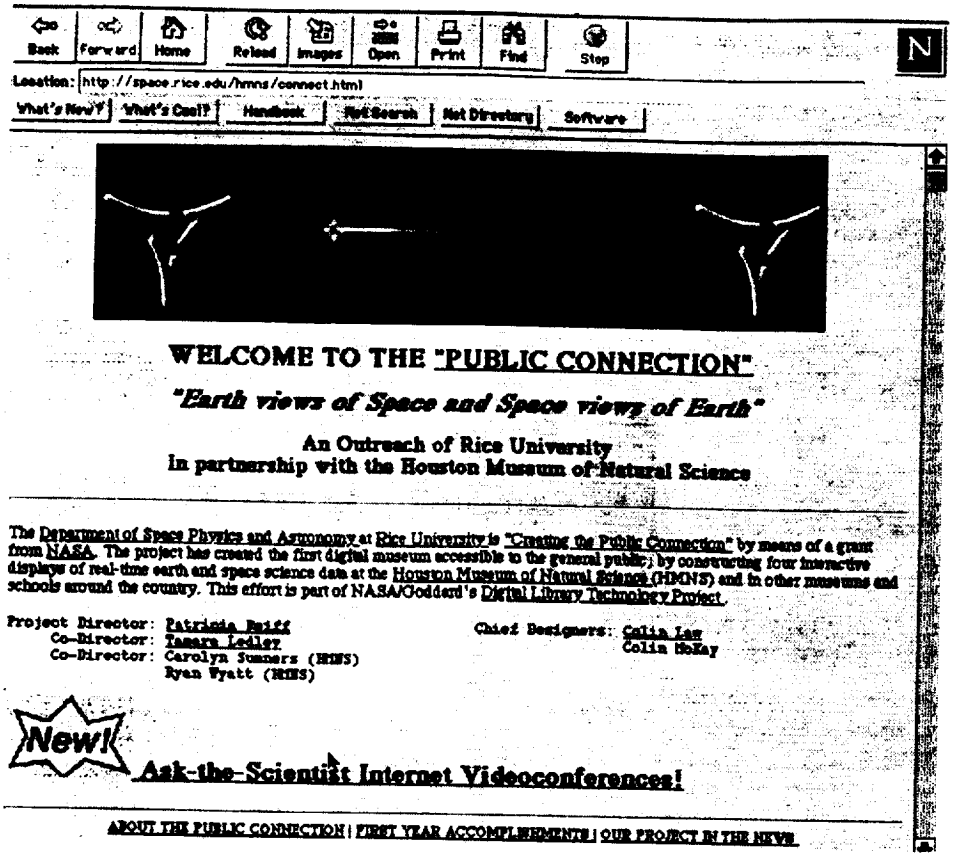
Concise tour of space weather information abstracted from a museum exhibit.

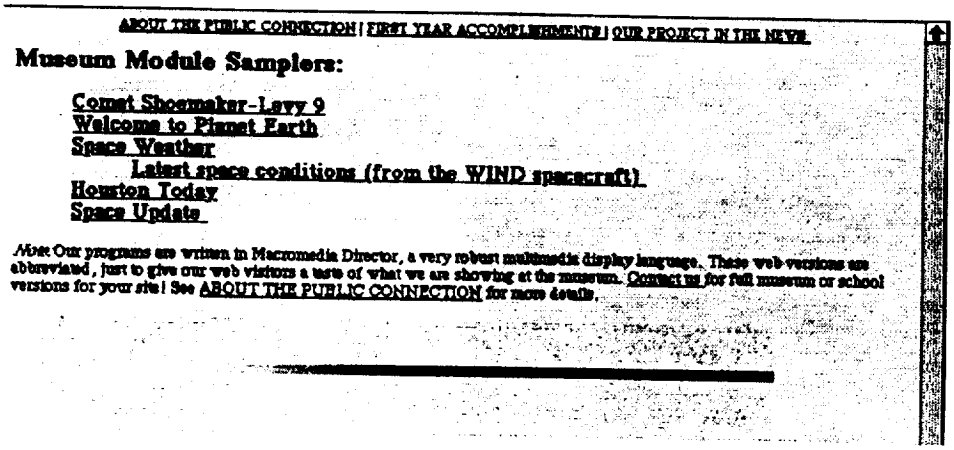
http://rigel.rice.edu/~dmb/spwea.html



Hot Links to real-time space weather data and forecasting sites.

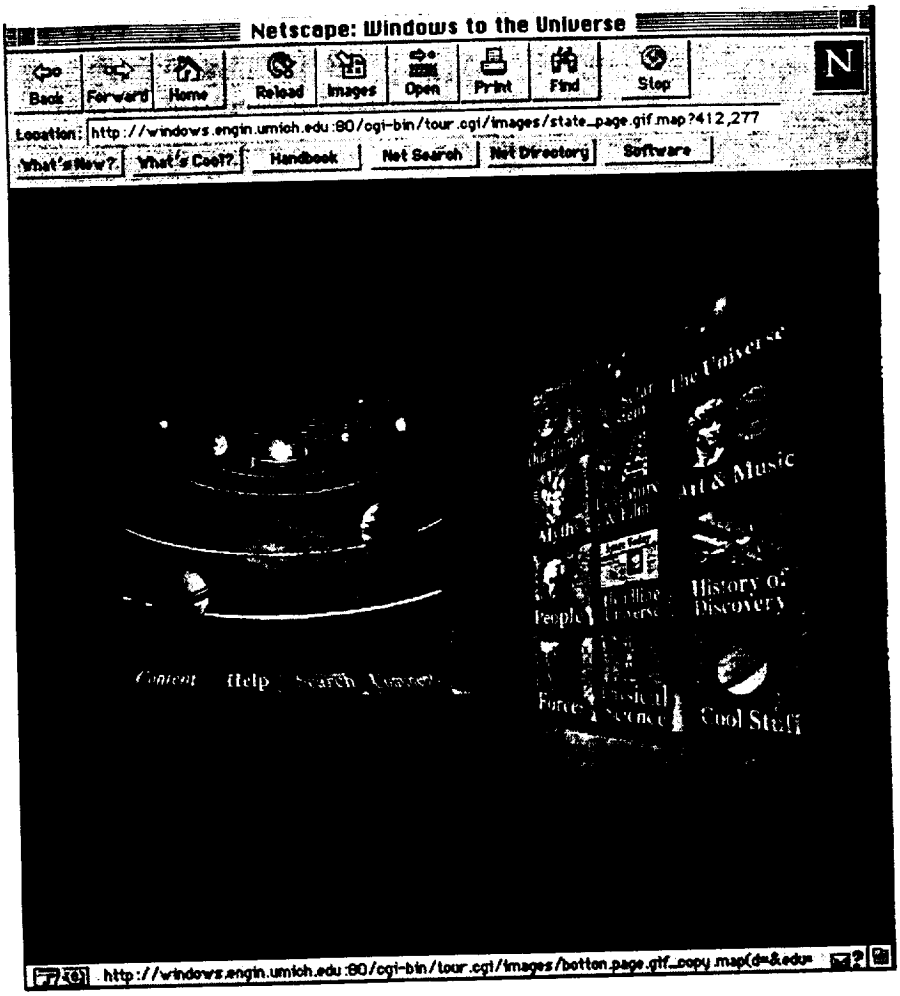
http://space.rice.edu/ISTP/





Shortened versions of museum exhibits on Space Weather and related topics.

http://space.rice.edu/hmns/connect.html



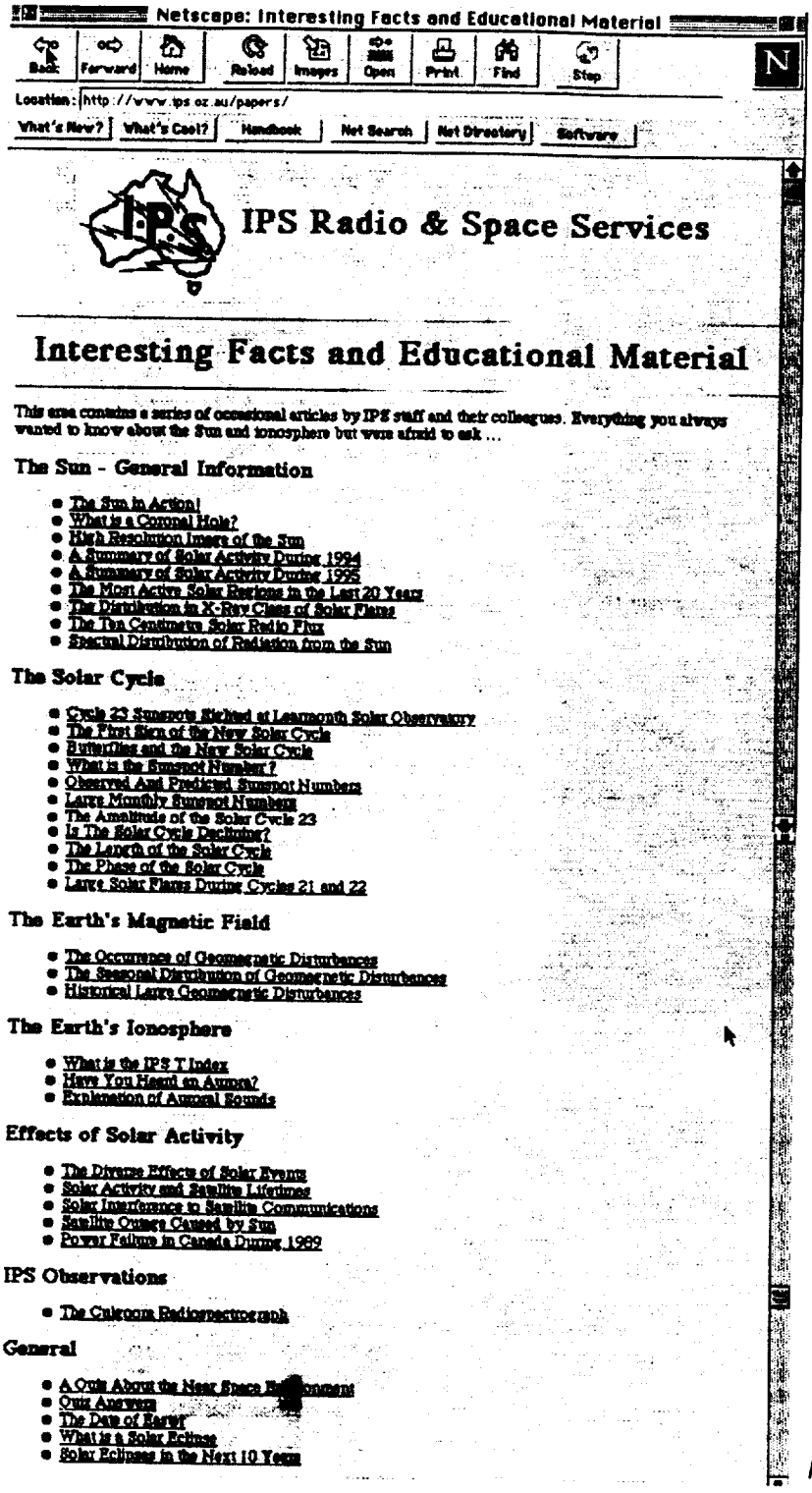
Watch For New Web Site Currently Under Development - Scheduled for Release February 28, 1996

Information about the Universe from the far reaches of space to the surface of the Earth.

Links to space physics, astronomy, astrophysics, and geophysics data bases.

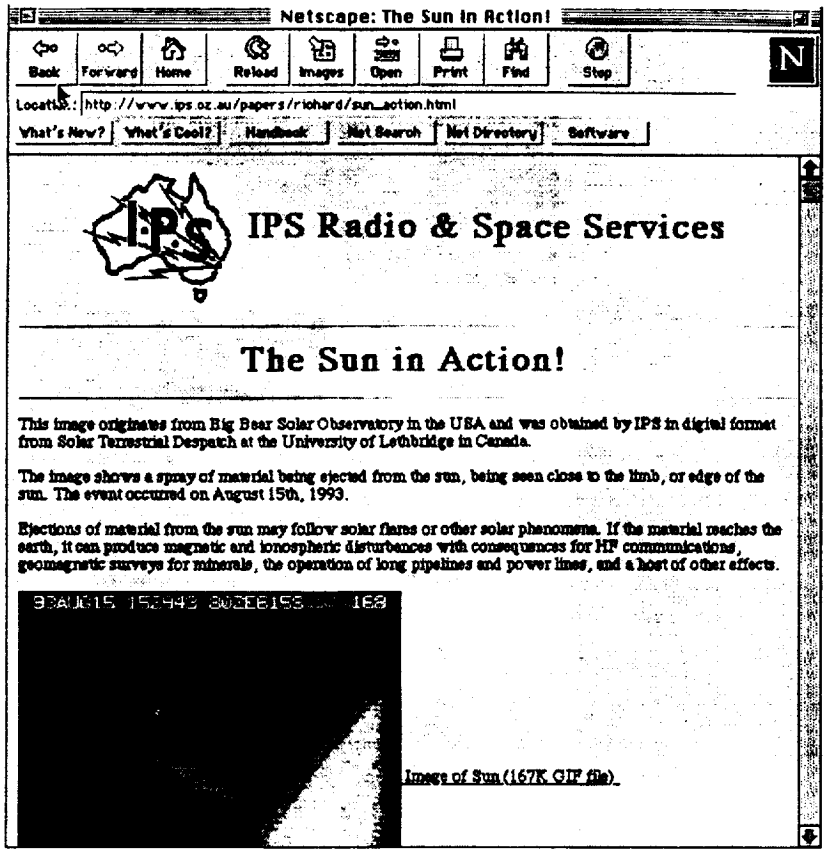
Initial deployment at Hands-on-Museum sites in Michigan.

http://windows.engin.umich.edu



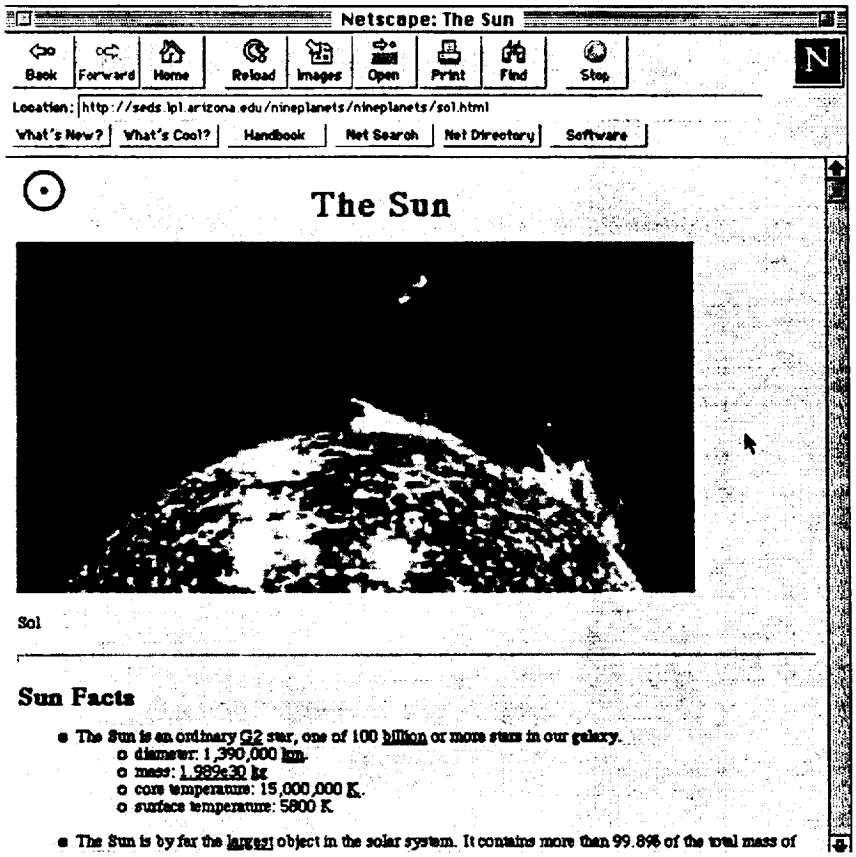
Very complete space weather information site with lots of interesting images.

http://www.ips.oz.au/papers/



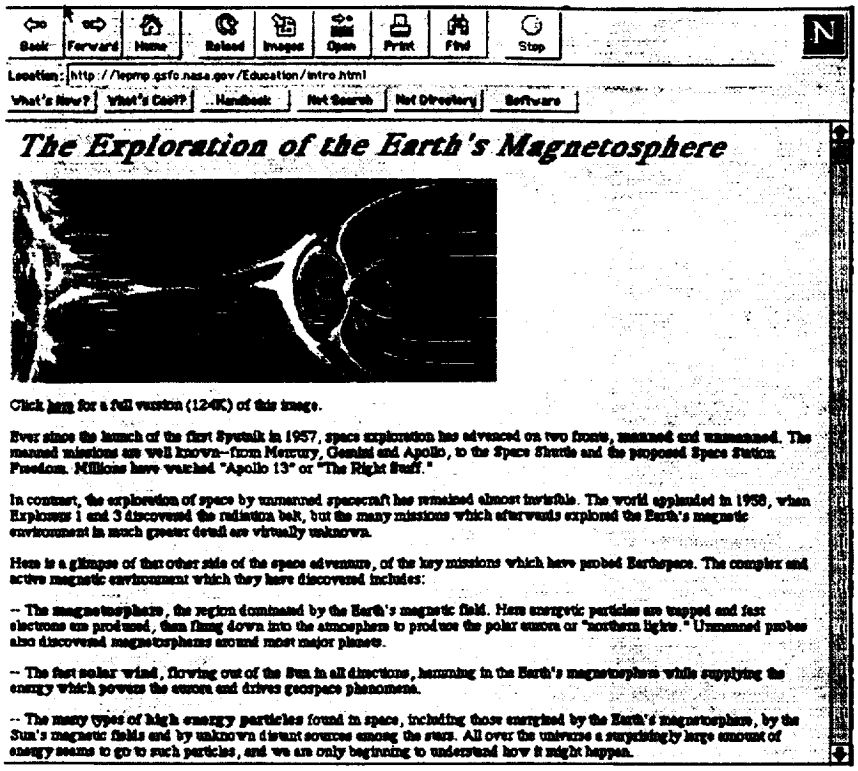
An example of the IPS science pages

http://www.ips.oz.au/papers /richard/sun_action.html



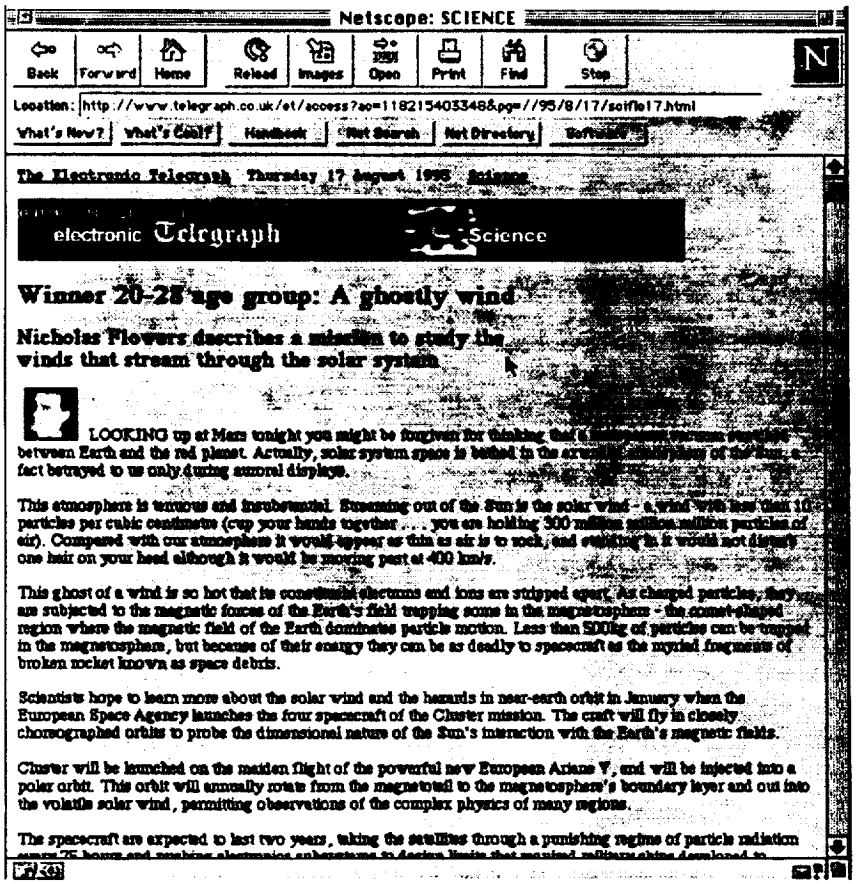
An enjoyable multi-media exploration of the sun.

http://seds.lpl.arizona.edu /nineplanets/sol.html



On-line review of the Earth's magnetosphere.

http://lepmp.gsfc.nasa.gov/Education/intro.html



Award winning article on the solar wind.

http://www.telegraph.co.uk/et/access?ac=118215403348&pg=//95/8/17/sciflo17.html

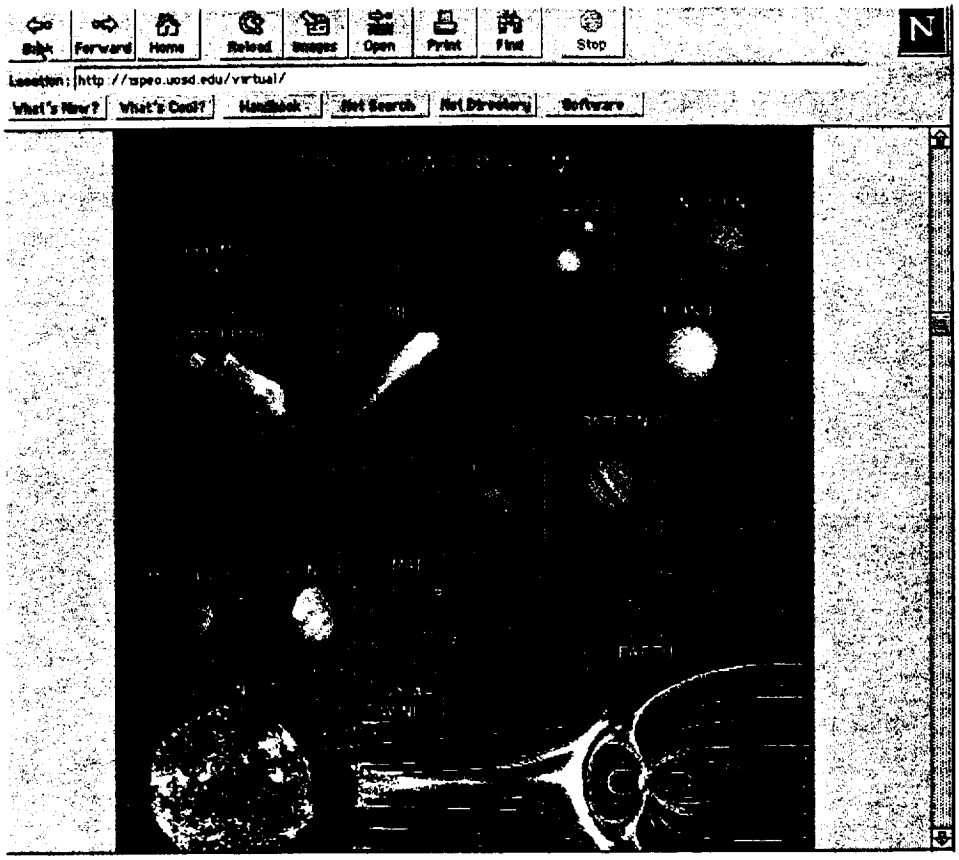
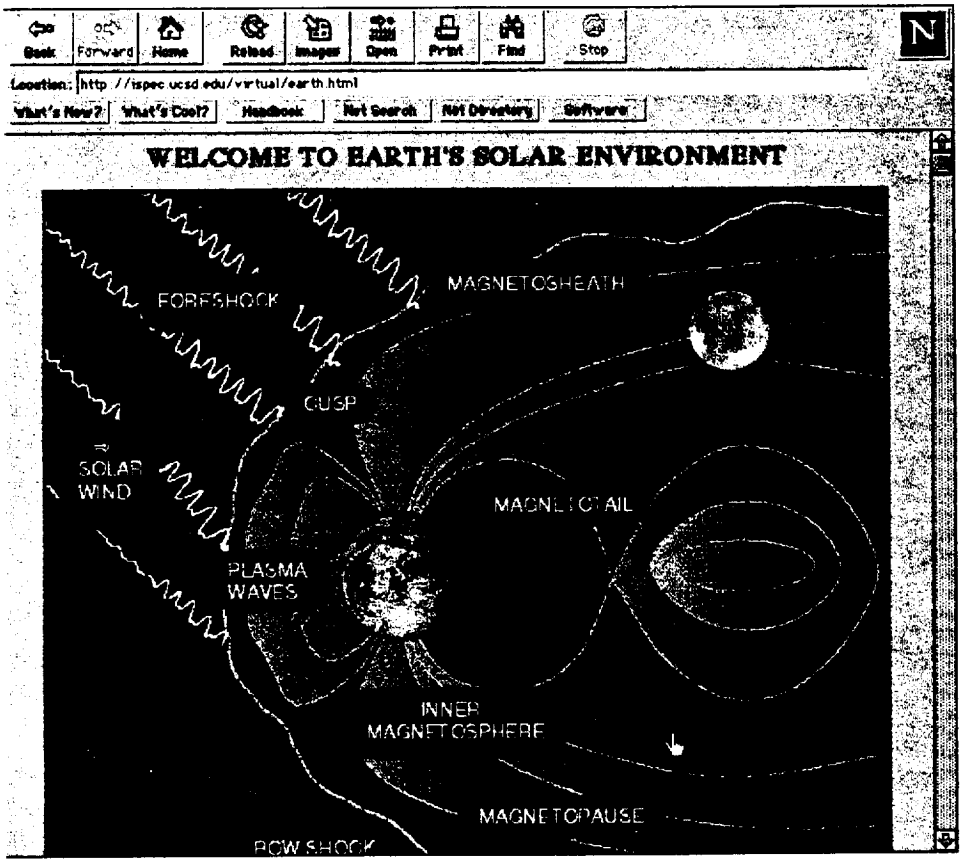
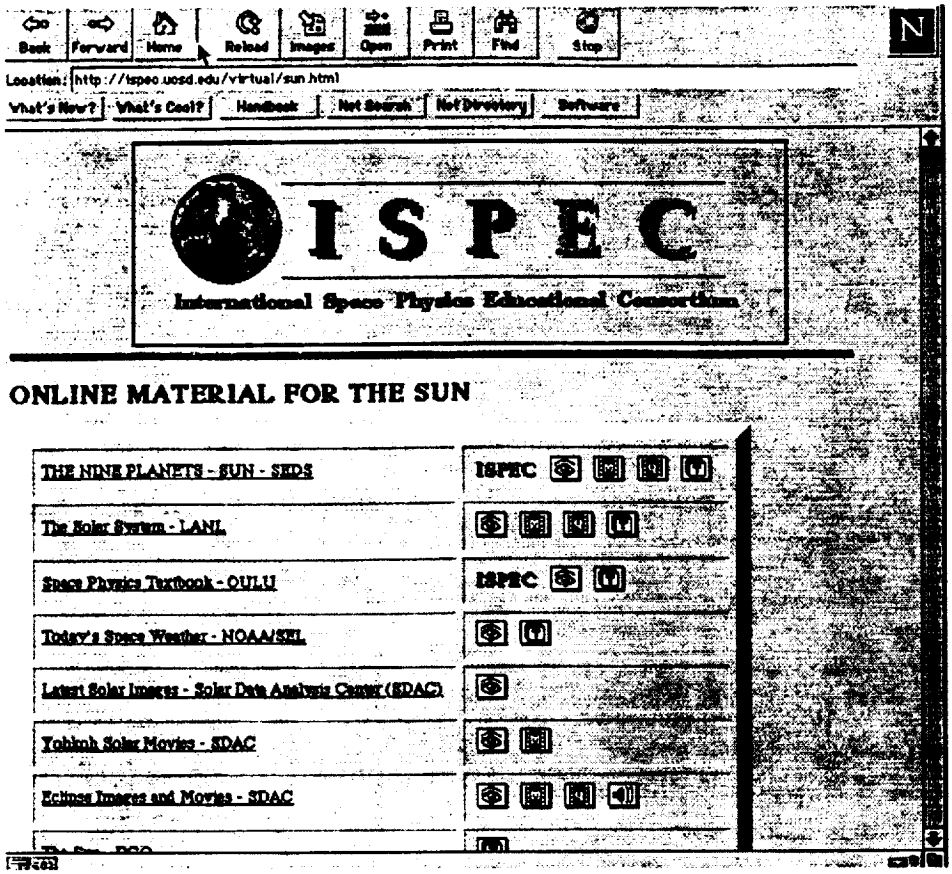


Image Intensive tour including the sun and the earth's plasma environment.

http://ispec.ucsd.edu/virtual/

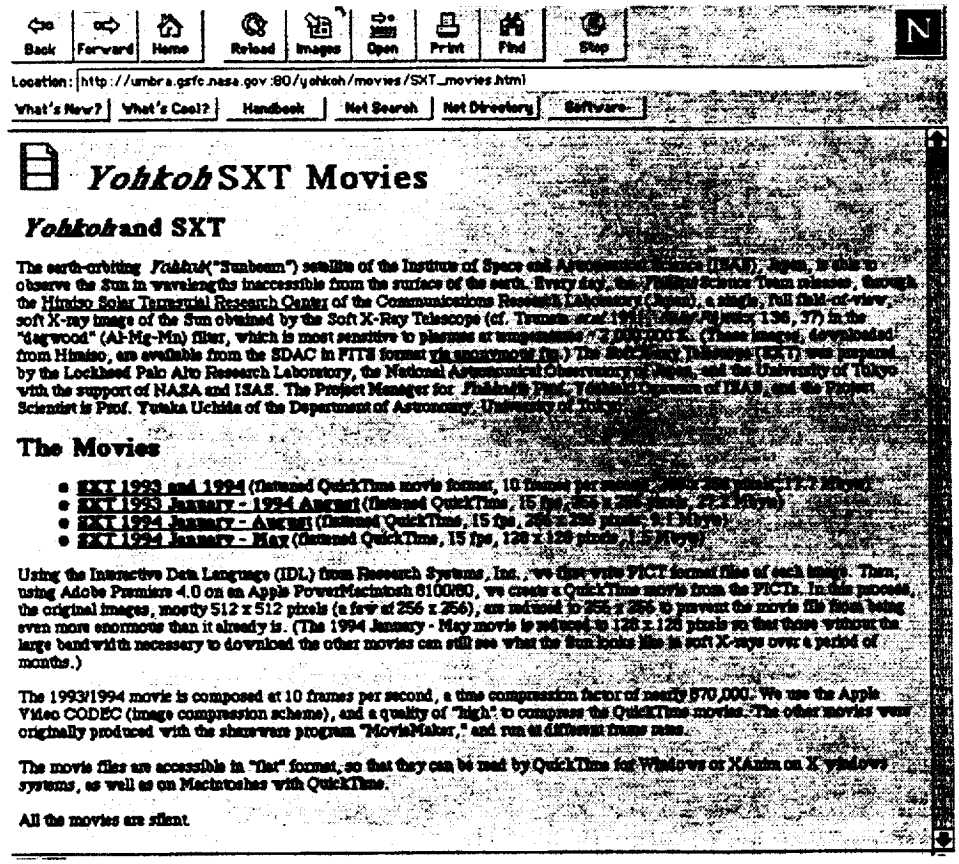


http://ispec.ucsd.edu/virtual/earth.html



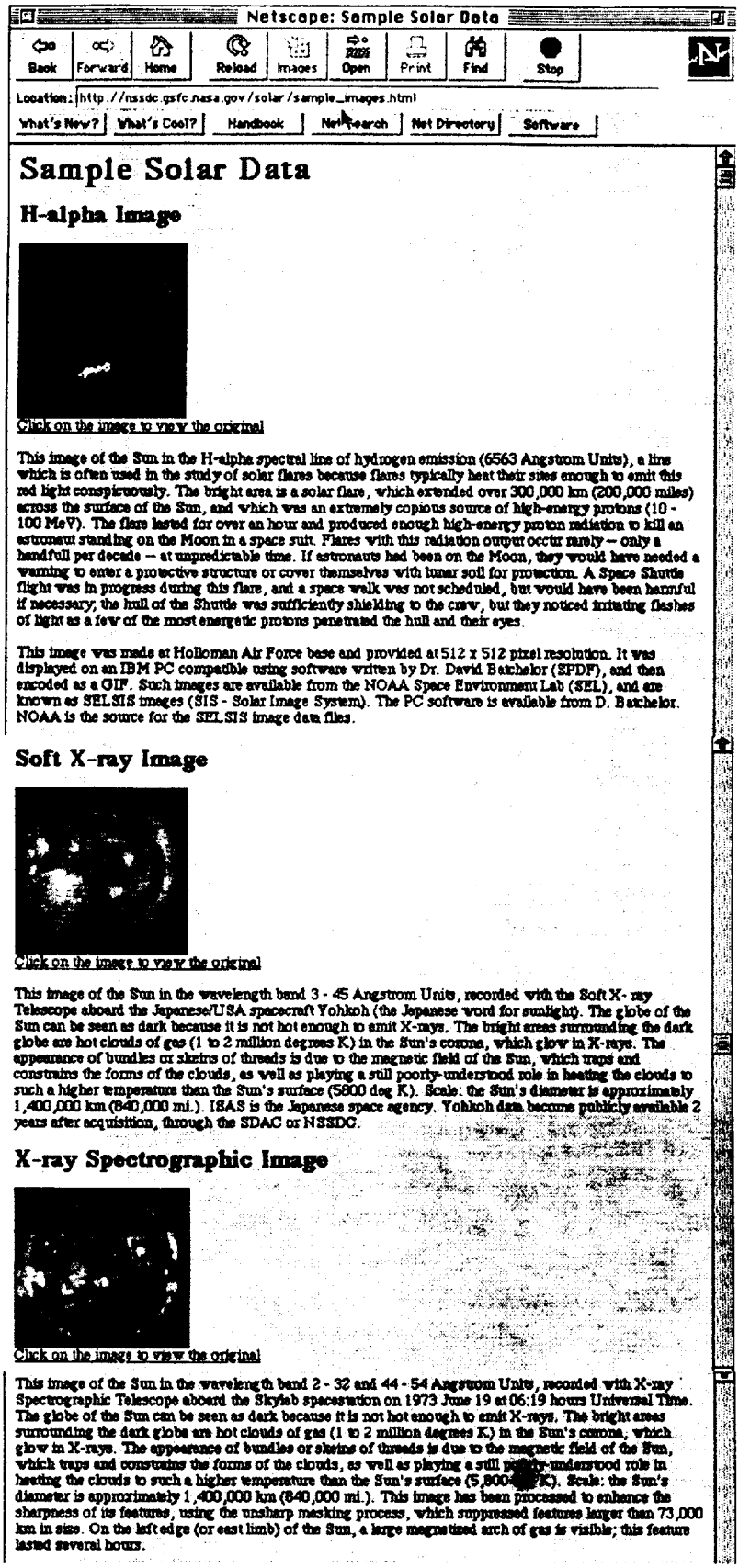
Sample of ISPEC HOT LINKS

http://ispec.ucsd.edu/ virtual/sun.html



Movies of the Sun in Soft Xrays

http://umbra.gsfc.nasa.gov:80/ yohkoh/movies/SXT_movies.html



Provides insights into the uses and interpretation of various types of solar images.

http://nssdc.gsfc.nasa.gov/solar/sample_images.html

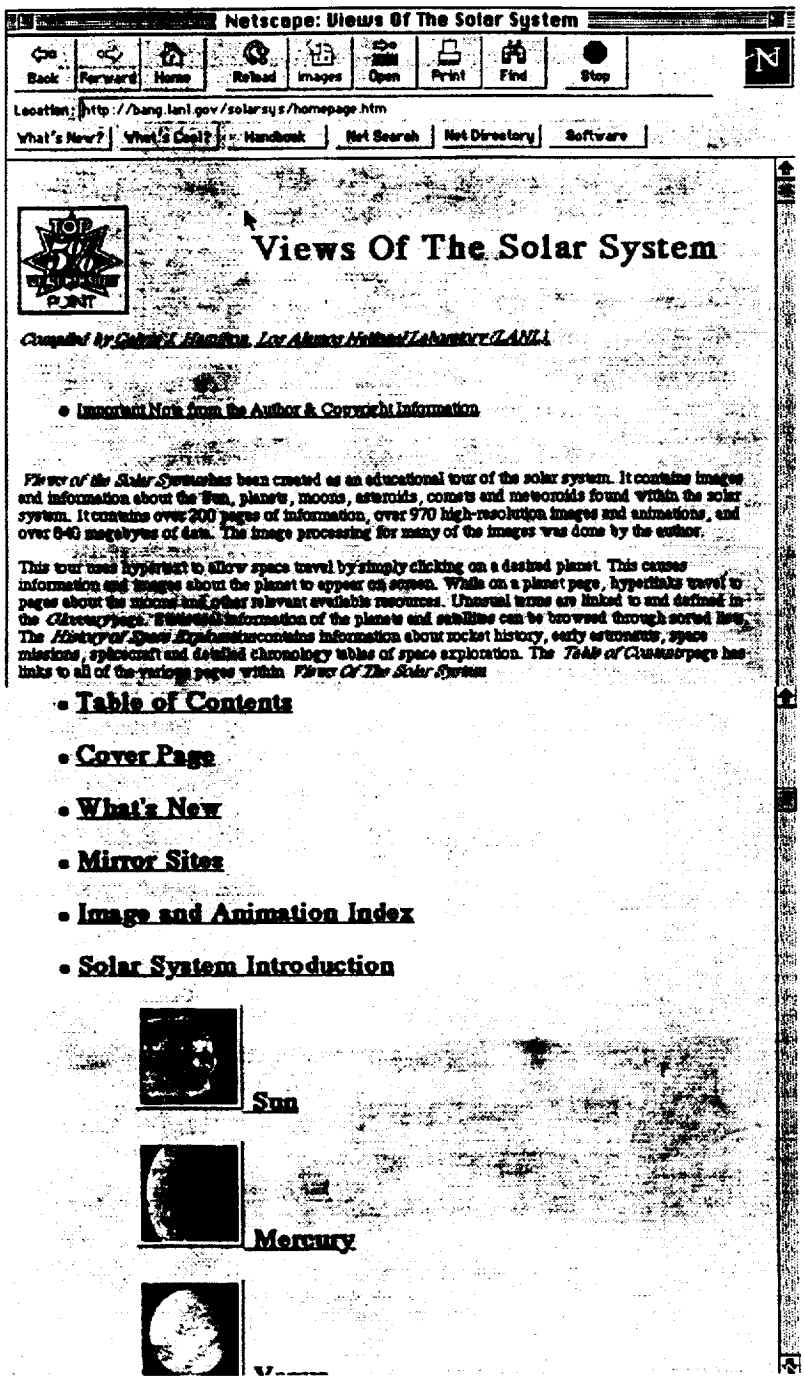
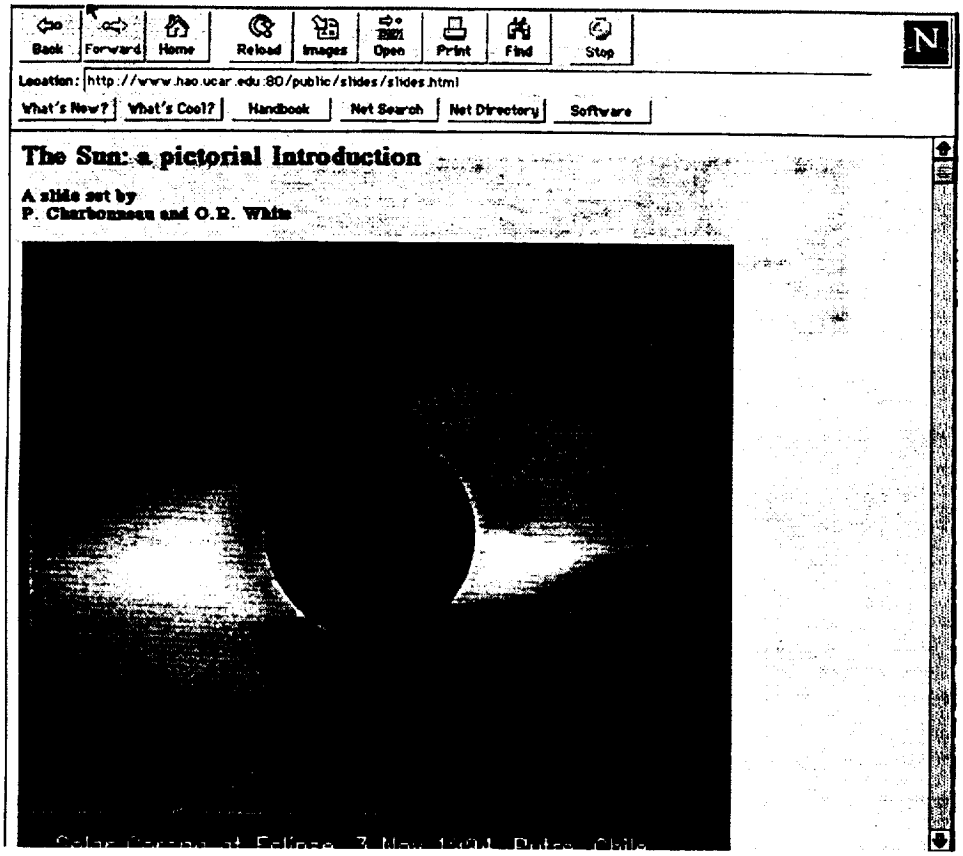
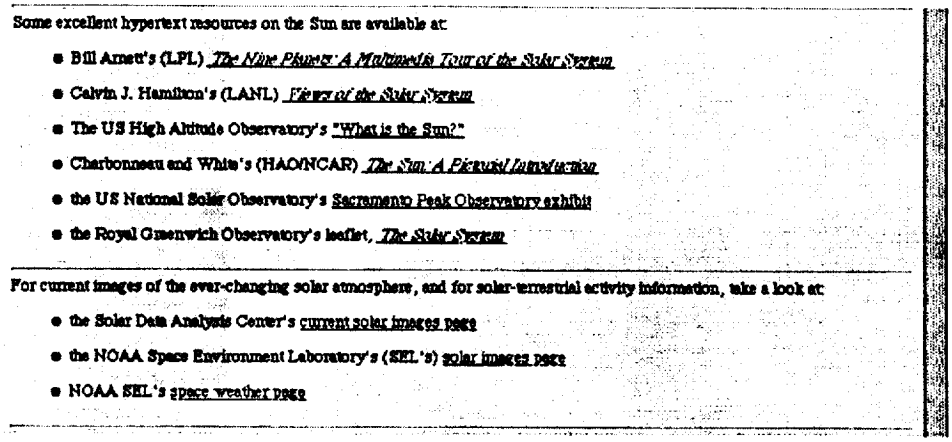


Image-intensive tour of the sun and planets.

http://bang.lanl.gov/solarsys/homepage.htm



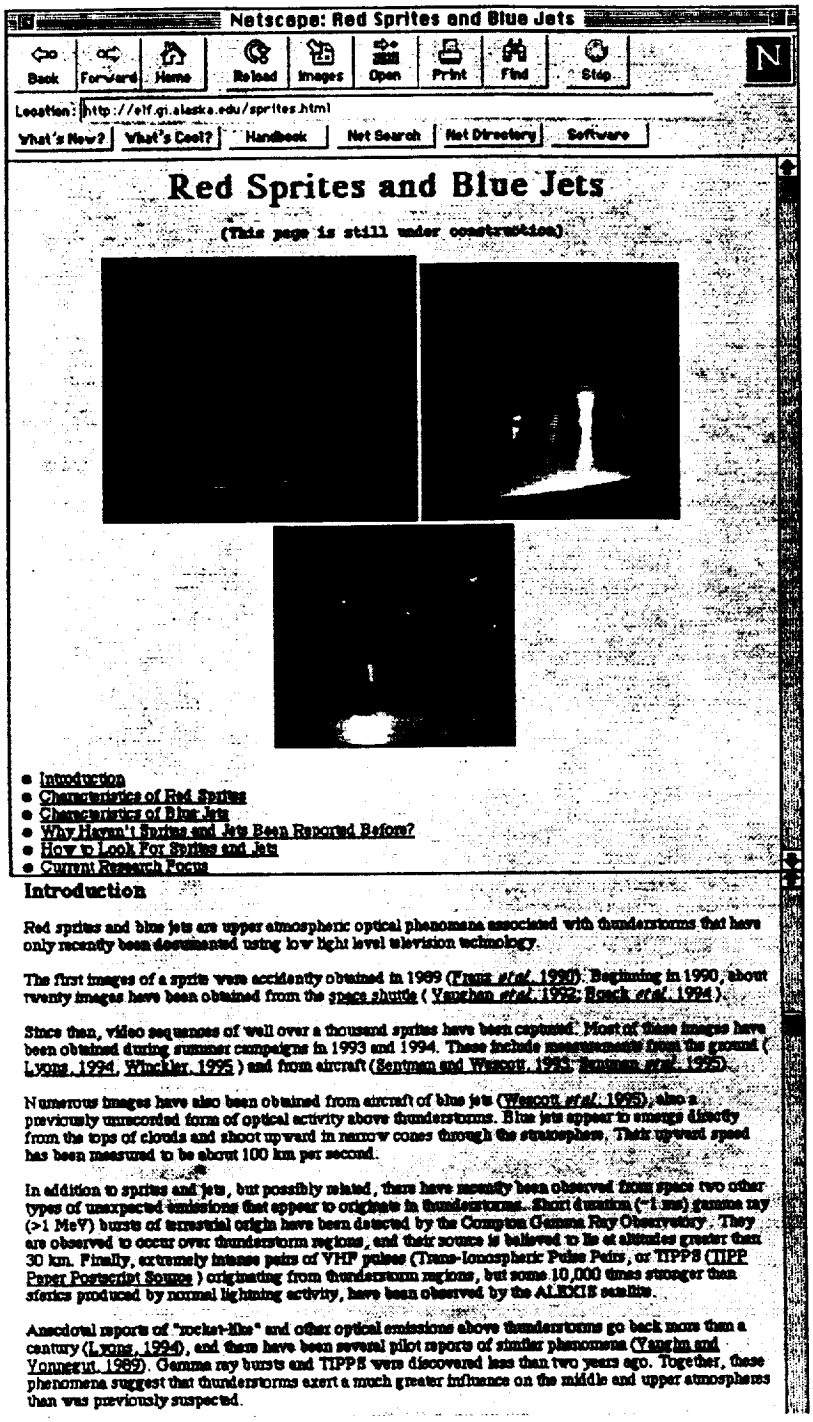
Very informative and visually appealing slide show of solar phenomena.



Useful Hot Links

http://www.hao.ucar.edu:80/public/slides/slides.html

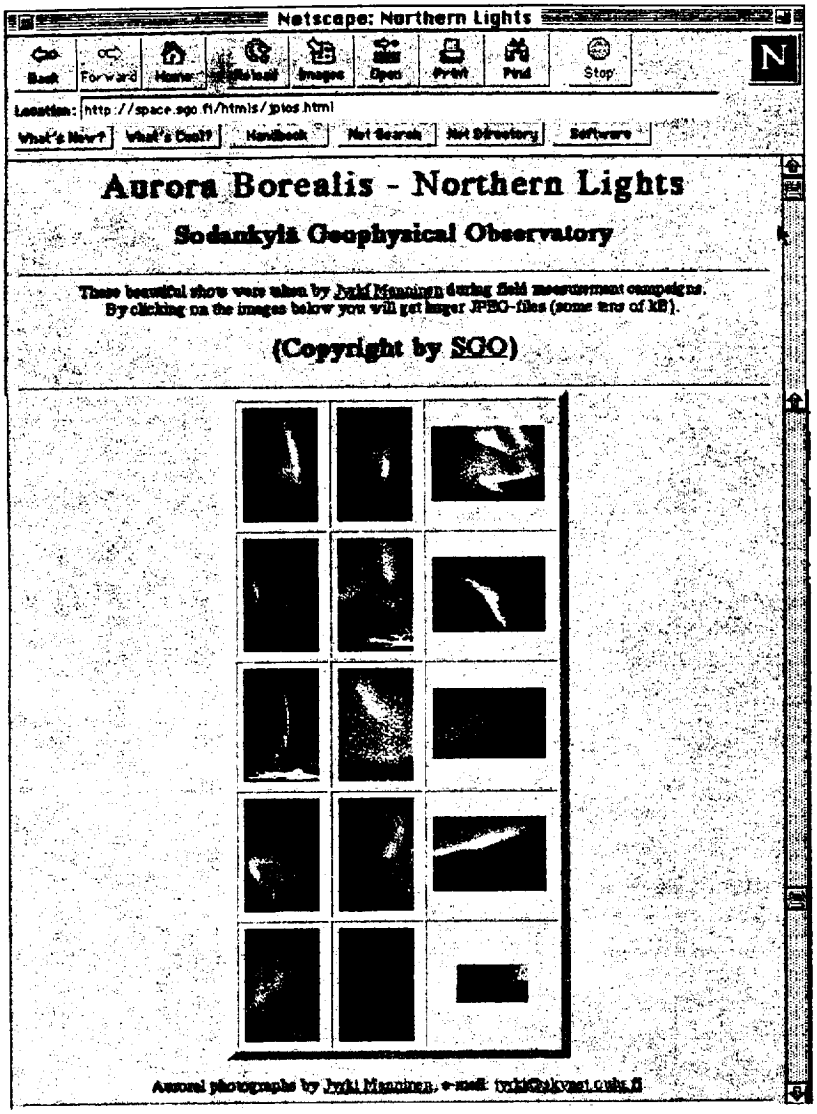
Atmospheric Phenomena in the Virtual Library



New Phenomena

Web site offering images, historical notes and research summary of the curious, newly-documented upward lightning discharges.

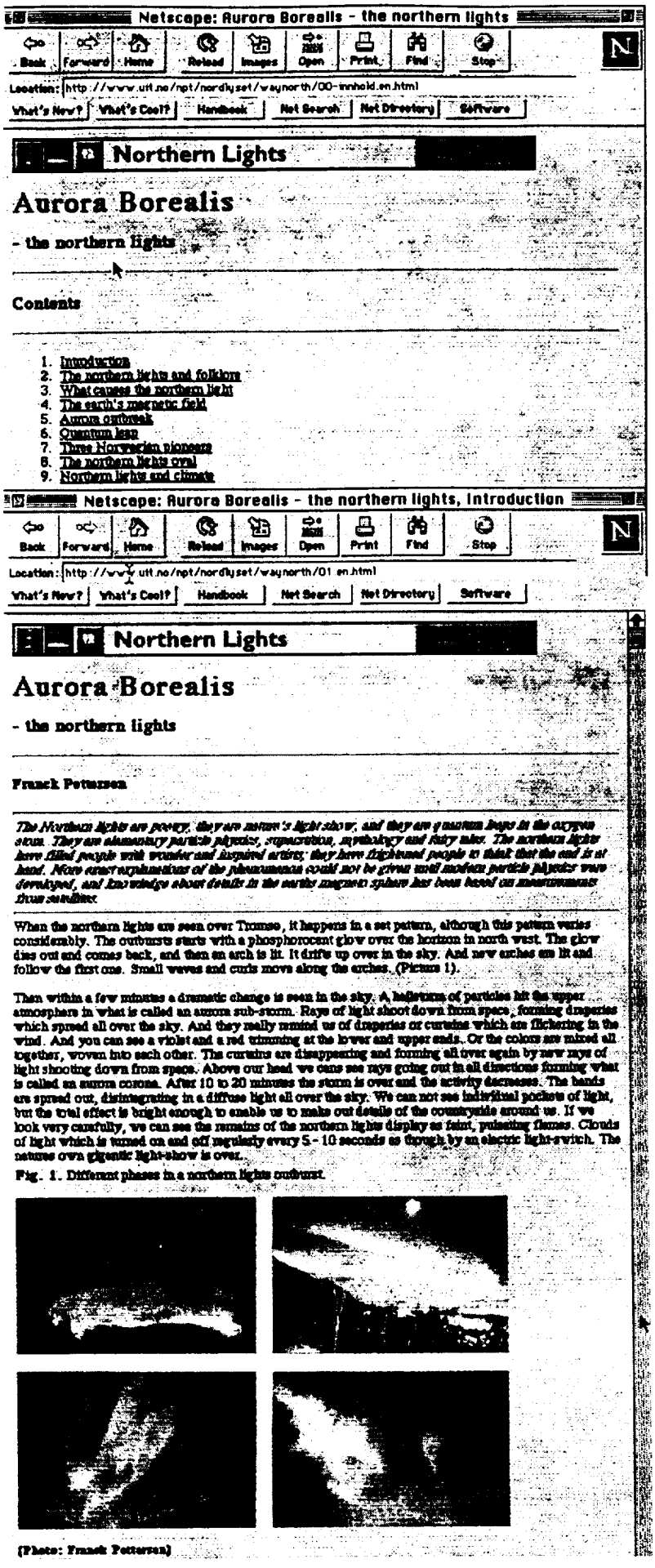
http://elf.gi.alaska.edu /sprites.html



Breathtaking Auroral Sites

A gallery of auroral images from Finland.

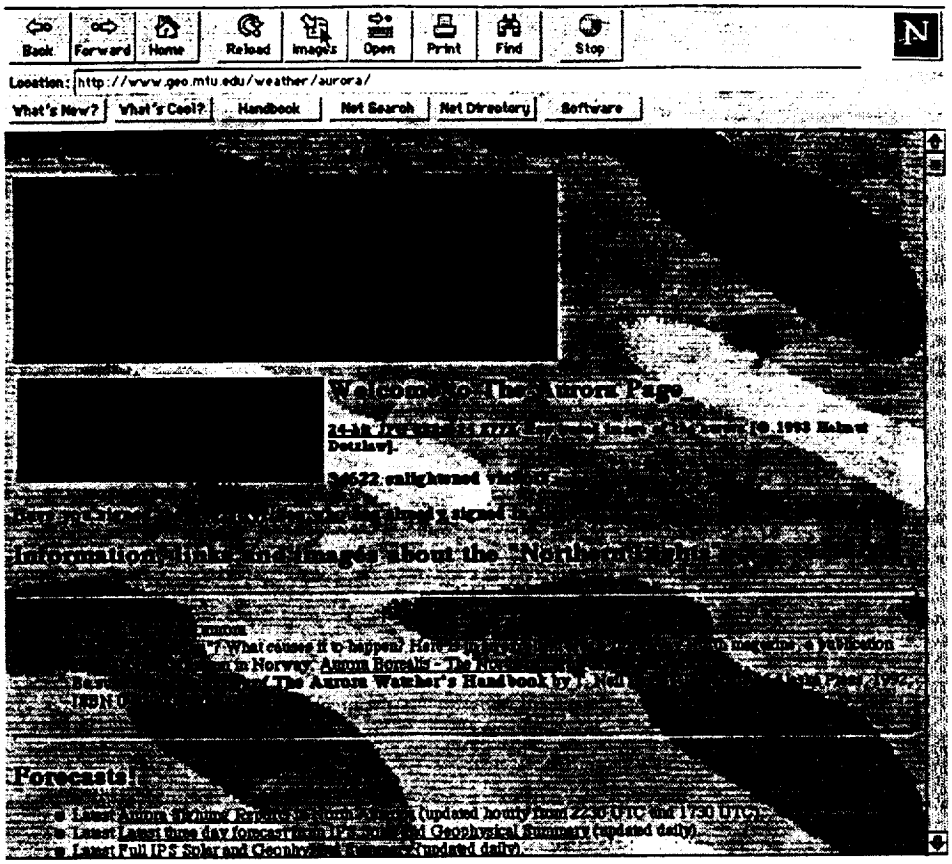
http://space.sgo.fi /htmls/jpics.html



Interesting source of information on the aurora and its history.

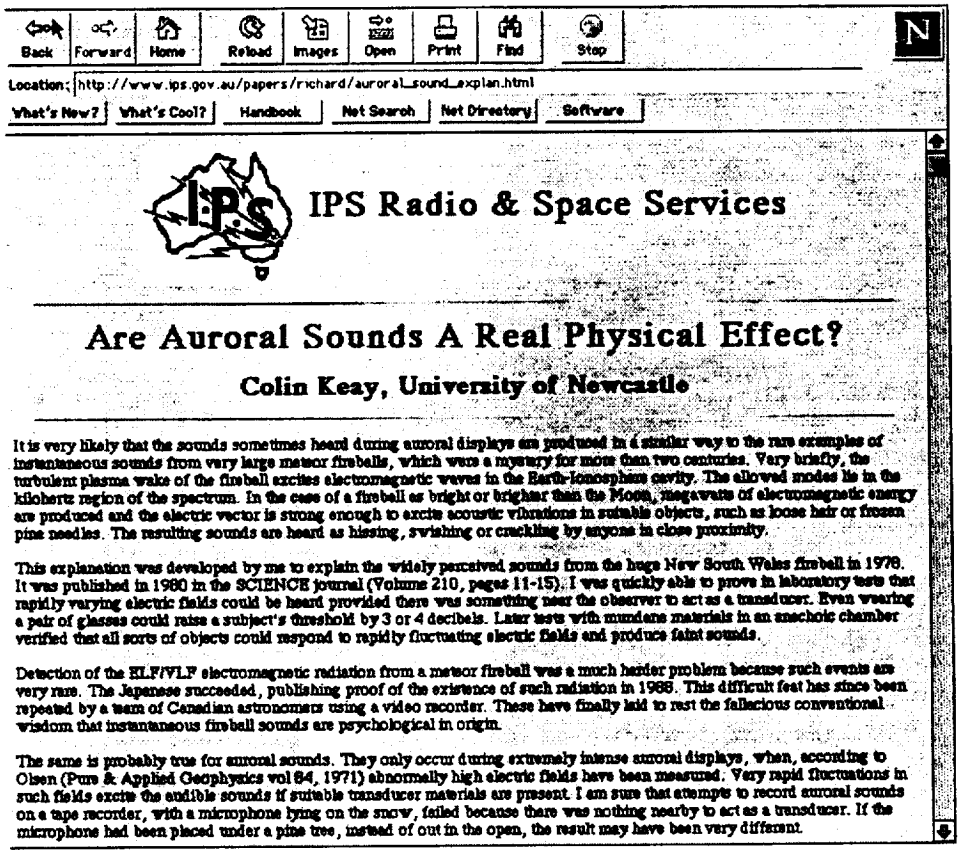
http://www.uit.no/npt/nordlyset/waynorth/OO-innhold.en.html

http://www.uit.no/npt/nordlyset/waynorth/O1.en.html



Beautiful auroral images from Northern Michigan.

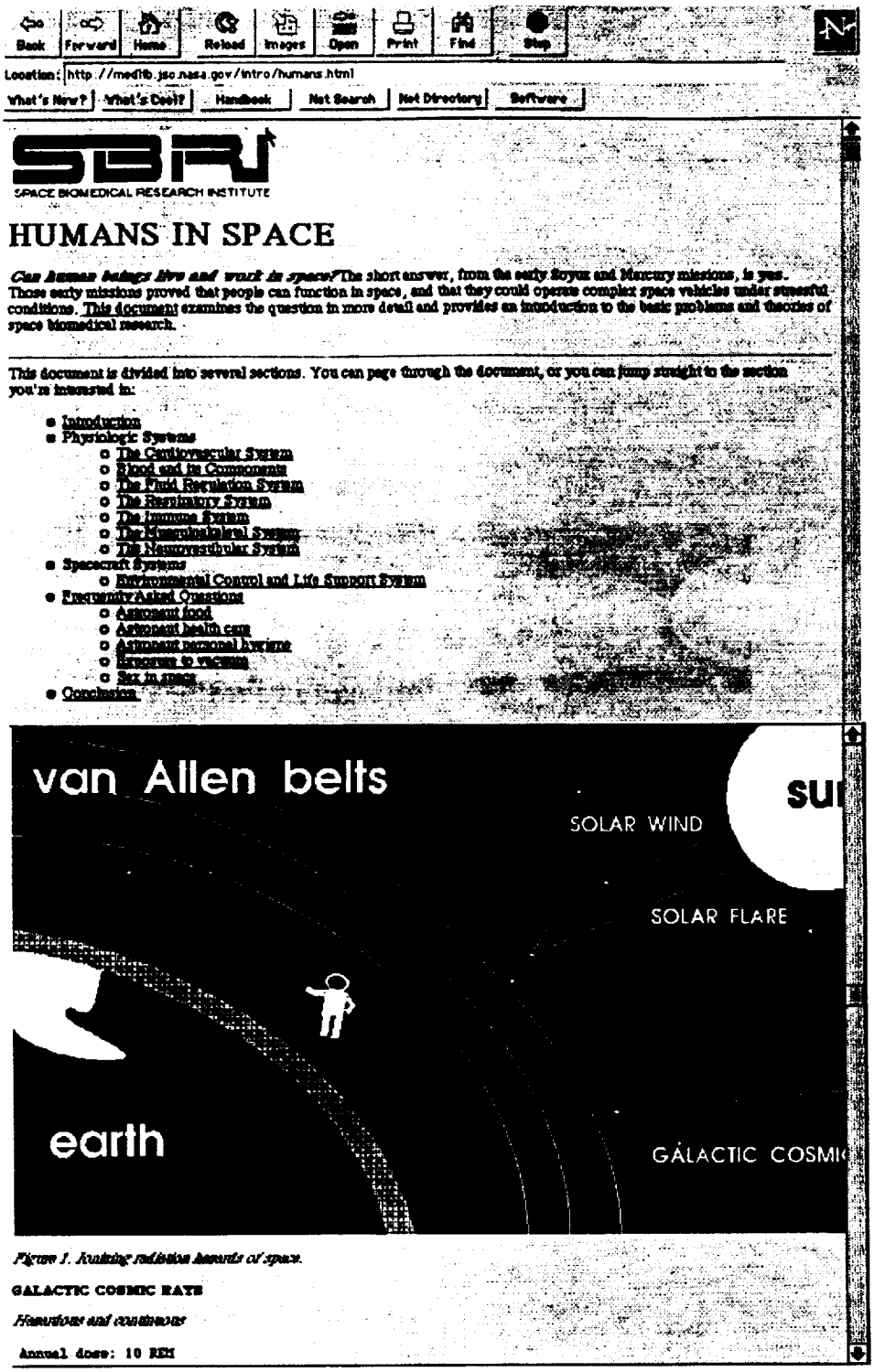
http://www.geo.mtu.edu /weather/aurora/



An exploration of the mystery of auroral sounds.

http://www.ips.gov.au/papers/ richard/auroral_sound_explan.html

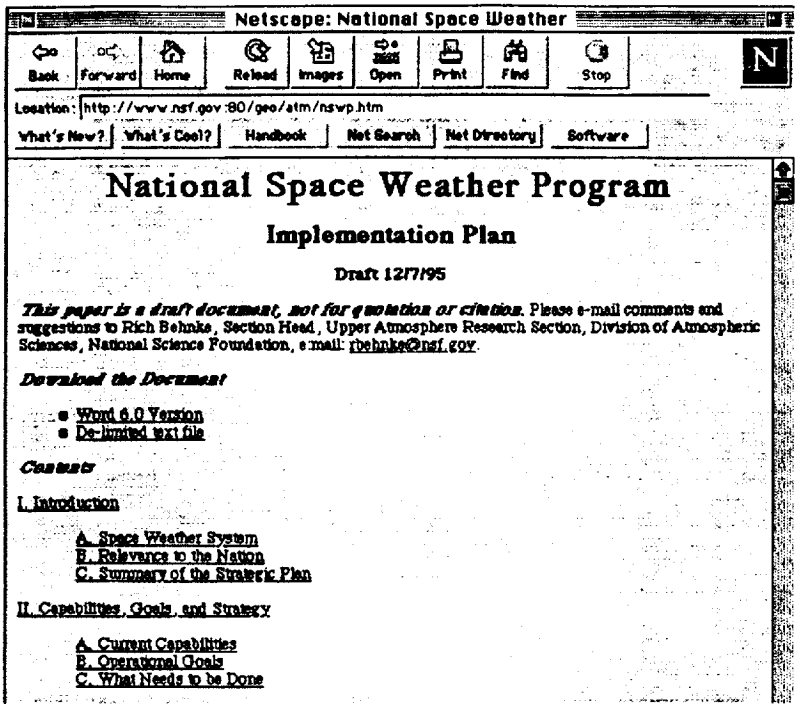
Effects of the Space Environment



Discussion of the impacts of the space environment on humans with an interesting section on radiation hazards.

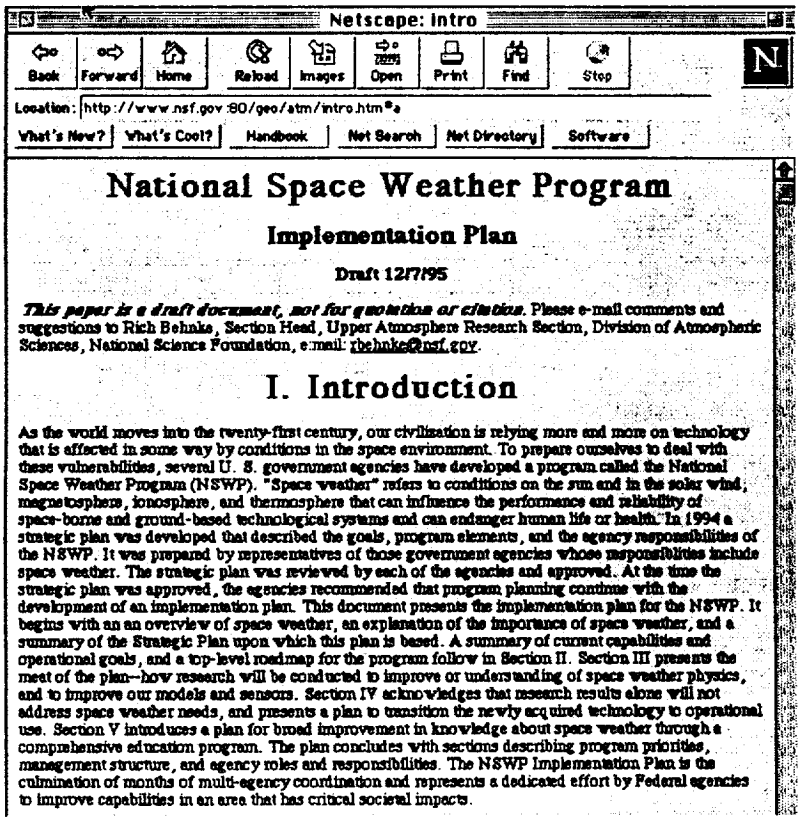
http://medlib.jsc.nasa.gov /intro/humans.html

Space Weather Prediction Infrastructure

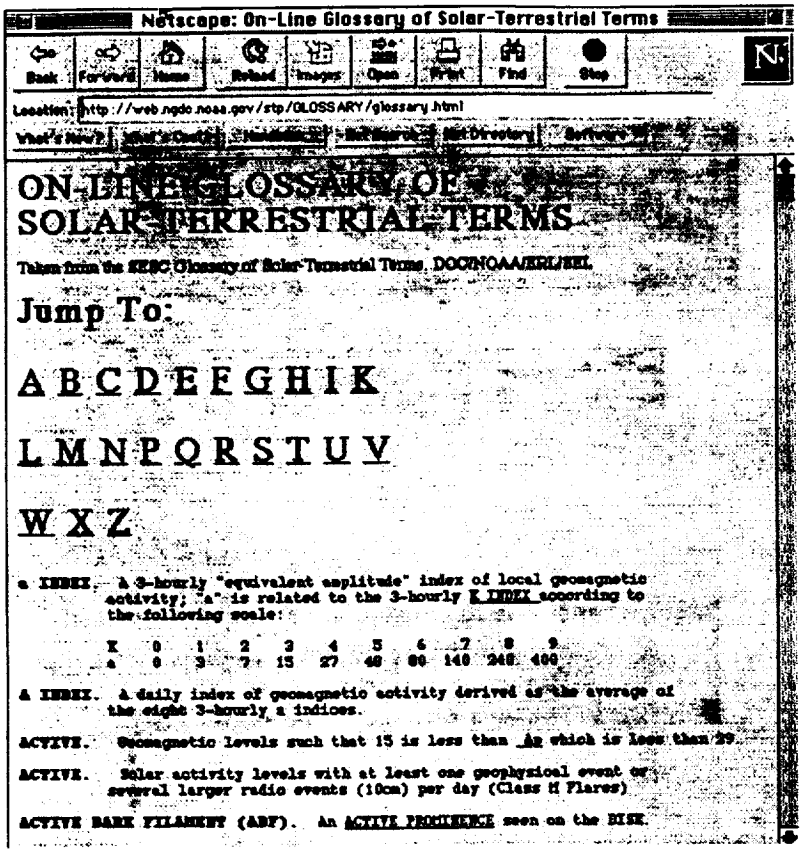


Draft Interagency Space Weather Implementation Plan

http://www.nsf.gov:80 /geo/atm/nswp.htm

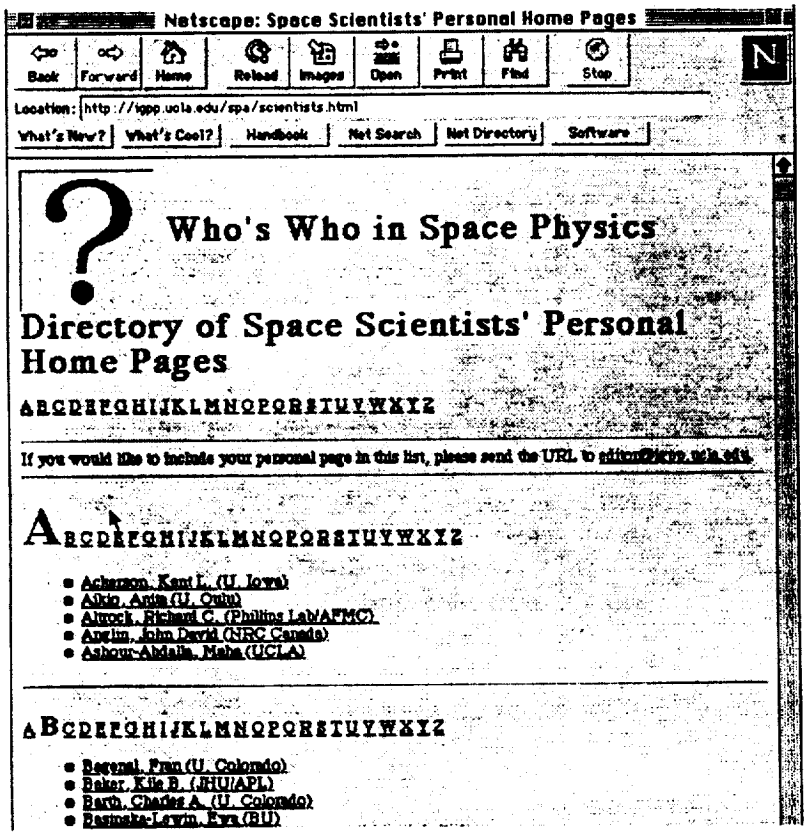


http://www.nsf.gov:80 /geo/atm/intro.htm#a



Handy reference for defining space weather terms.

http://web.ngdc.noaa.gov/stp/GLOSSARY/glossary.html

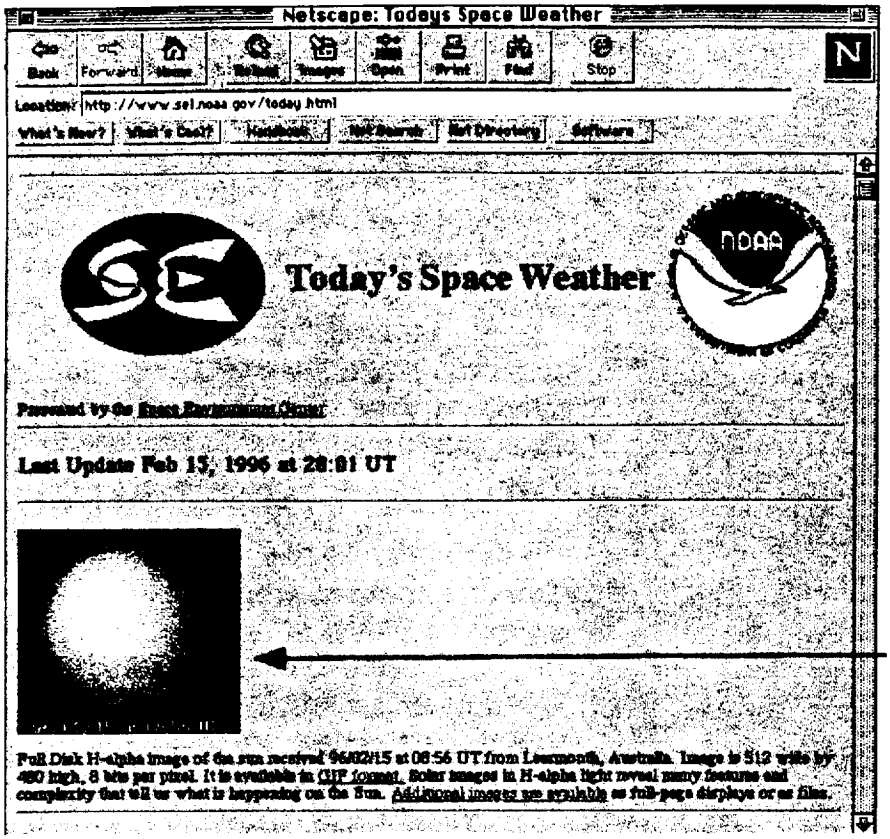


Links to the web home pages of space scientists (not comprehensive but growing)

http://igpp.ucla.edu/spa/scientists.html

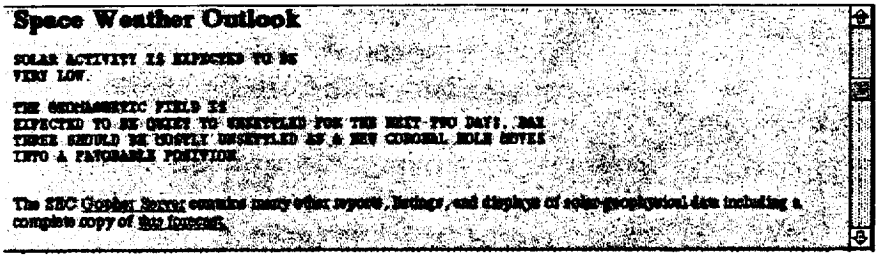
Real-Time Data and Forecasting Sites

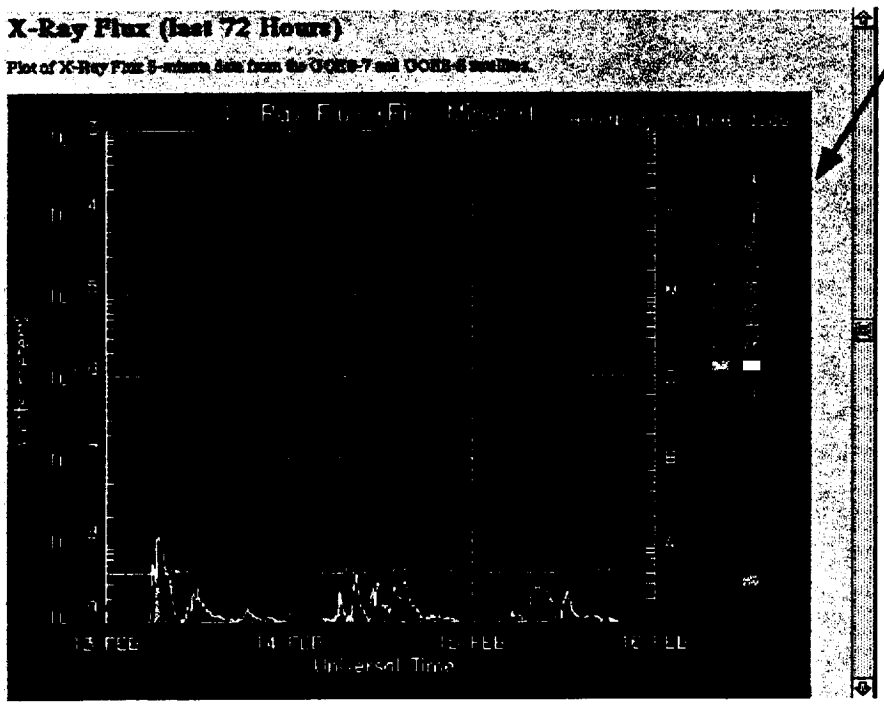
Unprecedented access to real-time data streams is now available on the web for browsers who want up to the minute knowledge of weather conditions in space.



Real-time information on solar conditions and the state of the Earth's magnetosphere are available at SEL's web site. Space Weather predictions are made daily. The following brief bullets describe the types of real-time data displayed and what to look for in these data displays.

An image of the solar disk in H-alpha line is provided daily. This type of light originates in the chromosphere (which lies just above the visible surface). Solar active regions (flares, plages, filaments, sunspot groups) are easily seen at these wavelengths. A large solar flare can release up to 10^{32} ergs in 1000 seconds and fills space with ultraviolet light, xrays and energetic particles.

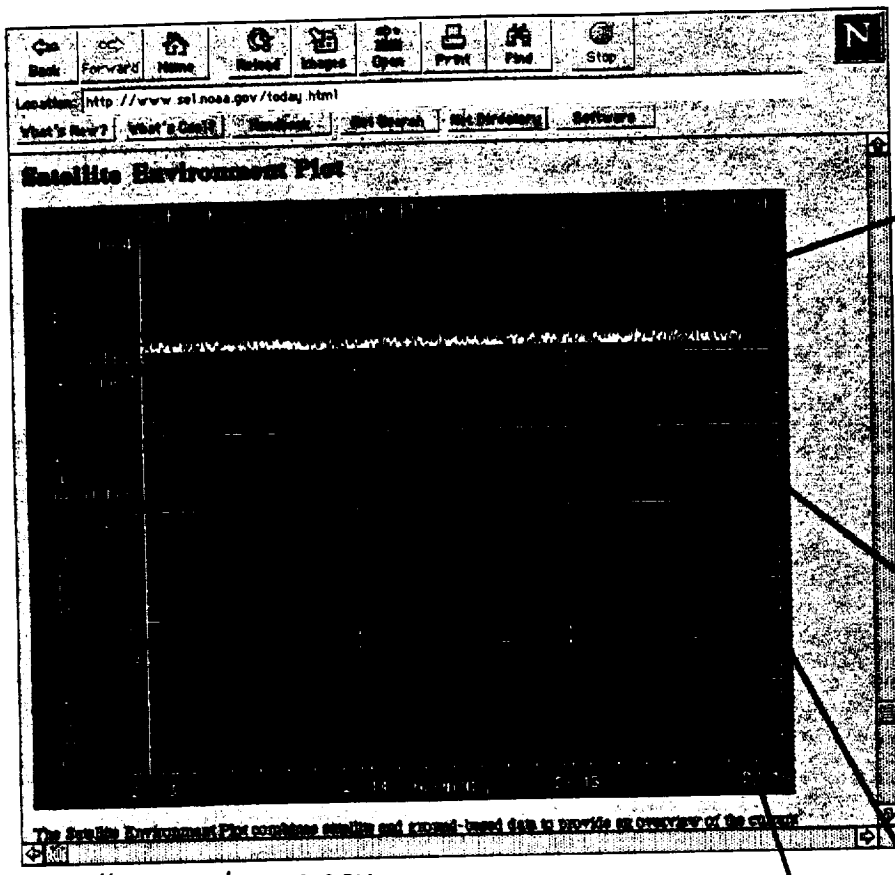




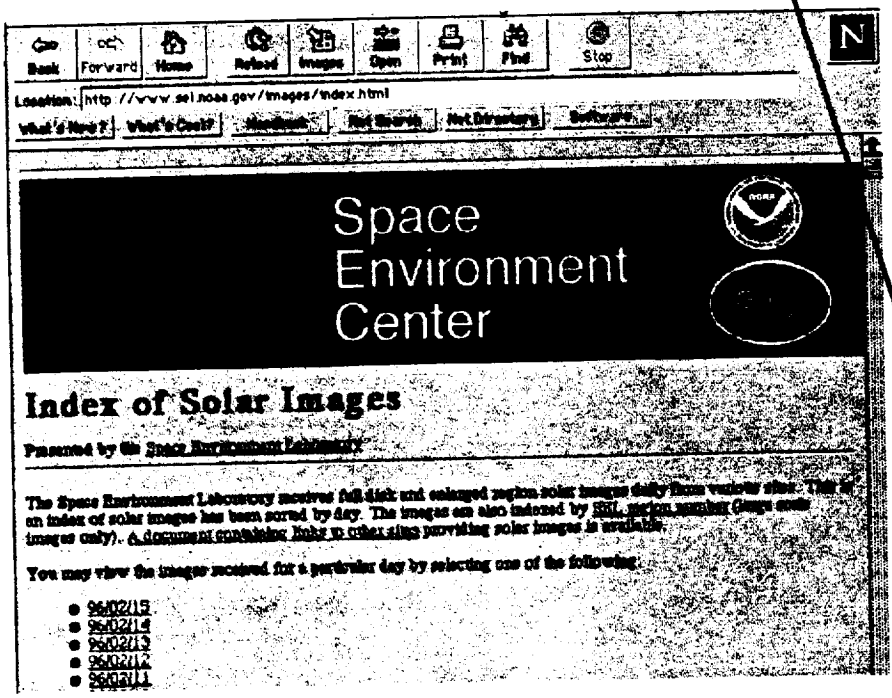
The xray fluxes, plotted in this panel, are the total fluxes arriving from the sun as seen at geosynchronous orbit by the GOES satellites. Flares produce greatly enhanced x-ray fluxes which reach the Earth within 8 minutes from the flare site on the sun. The levels here are low originating from a quiet sun. Enhanced levels can be seen associated with flares. Flares are classifed by their xray flux output as:

Class	Xray Flux ($x10^{-6}$ W/m^2)
C	1 - 10
M	10 - 100
X	> 100

http://www.sel.noaa.gov /today.html



http://www.sel.noaa.gov /today.html



http://www.sel.noaa.gov /images/index.html

This set of panels provides an overview of conditions encountered by satellites at geosynchronous orbit. Clicking on any panel to get an expanded view and some explanation of the plot parameters.

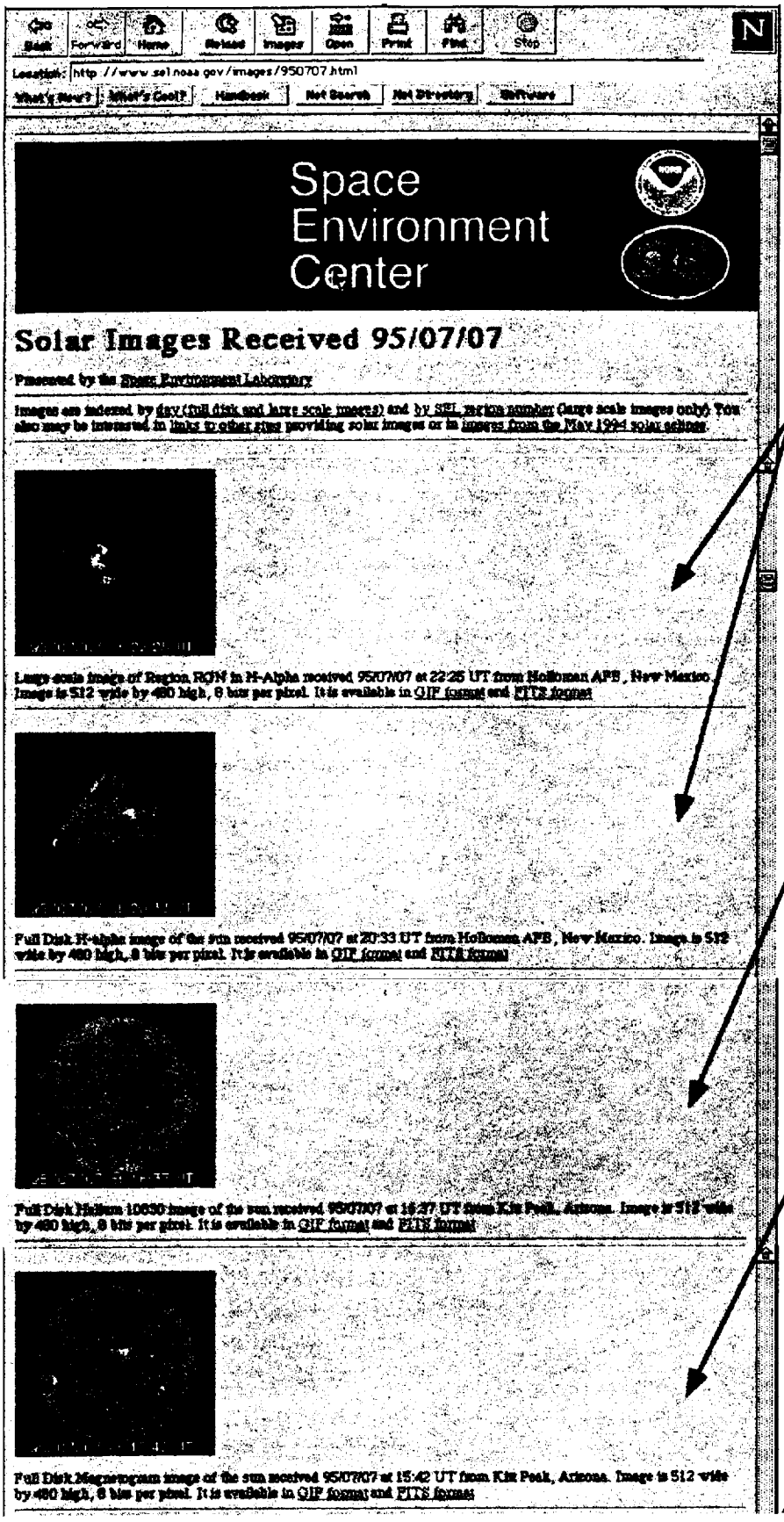
The first panel gives the summed proton flux over several energy ranges. When the >10 MeV proton flux (red line) reached a flux >10 protons/cm2/s/sr), warning of a suspected proton flare is issued. The dashed line indicates the level at which satellite anomalies have been seen.

The second panel gives the summed electron flux over several energy ranges. When the >2 MeV flux (red line) exceeds 1000 electrons/cm2/s/sr a warning is issued. At this level, problems with spacecraft charging are known to have occurred.

Hp is a measure of the geosynchronous magnetic field component ~parallel to the Earth's rotation axis. If this field becomes negative on the dayside, the outer boundary of the Earth's magnetosphere has likely been pushed inside geosynchronous orbit exposing spacecraft to negative and highly variable magnetic fields.

The last panel gives the estimated planetary K index, which is a measure of the irregular variations in the Earth's magnetic field. The variations reflect the degree of magnetic activity (storminess).

Kp value	Conditions
4	active
5	minor storm
≥ 6	major or severe storm



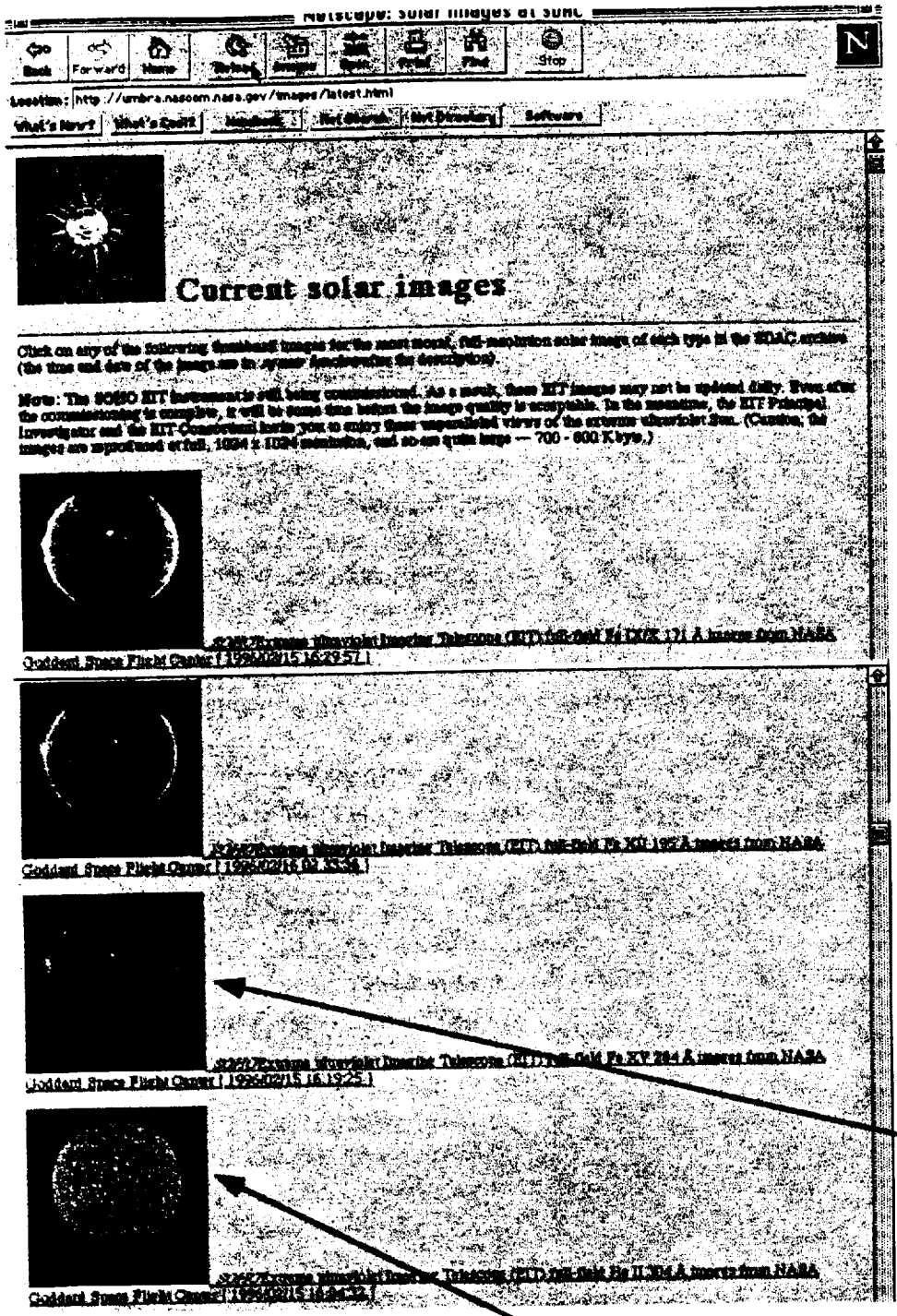
Solar images come in various wavelength ranges and each of these images has something different to tell us about conditions on the sun. A brief explanation is given for each type of image along with tips on what features are of interest.

The first two images are views at different resolutions of the sun in the red H-alpha emission line of hydrogen. This emission comes mainly from the chromosphere (the layer just above the sun's visible surface). Active regions (i.e., flares, plages, filaments, and sunspots) are highly visible at these wavelengths. Solar active regions are associated with the development of magnetic storms at the Earth.

The third image is a view of the full solar disk in He 10830 emission. From this emission line, information about the sun's corona (the sun's outermost layer, visible during eclipses) can be inferred. Active regions and prominences appear black, while coronal holes (associated with recurrent magnetic activity on the Earth) appear light.

The final image shows the polarity and surface distribution of the sun's magnetism. Dark regions have south polarity, bright regions north polarity. Sunspots usually appear in groups of two with opposite polarity. Polarities are reversed as you move from the sun's northern to southern hemisphere.

http://www.sel.noaa.gov /images/950707.html



http://umbra.nascom.nasa.gov /images/latest.html

The latest SOHO images of the sun

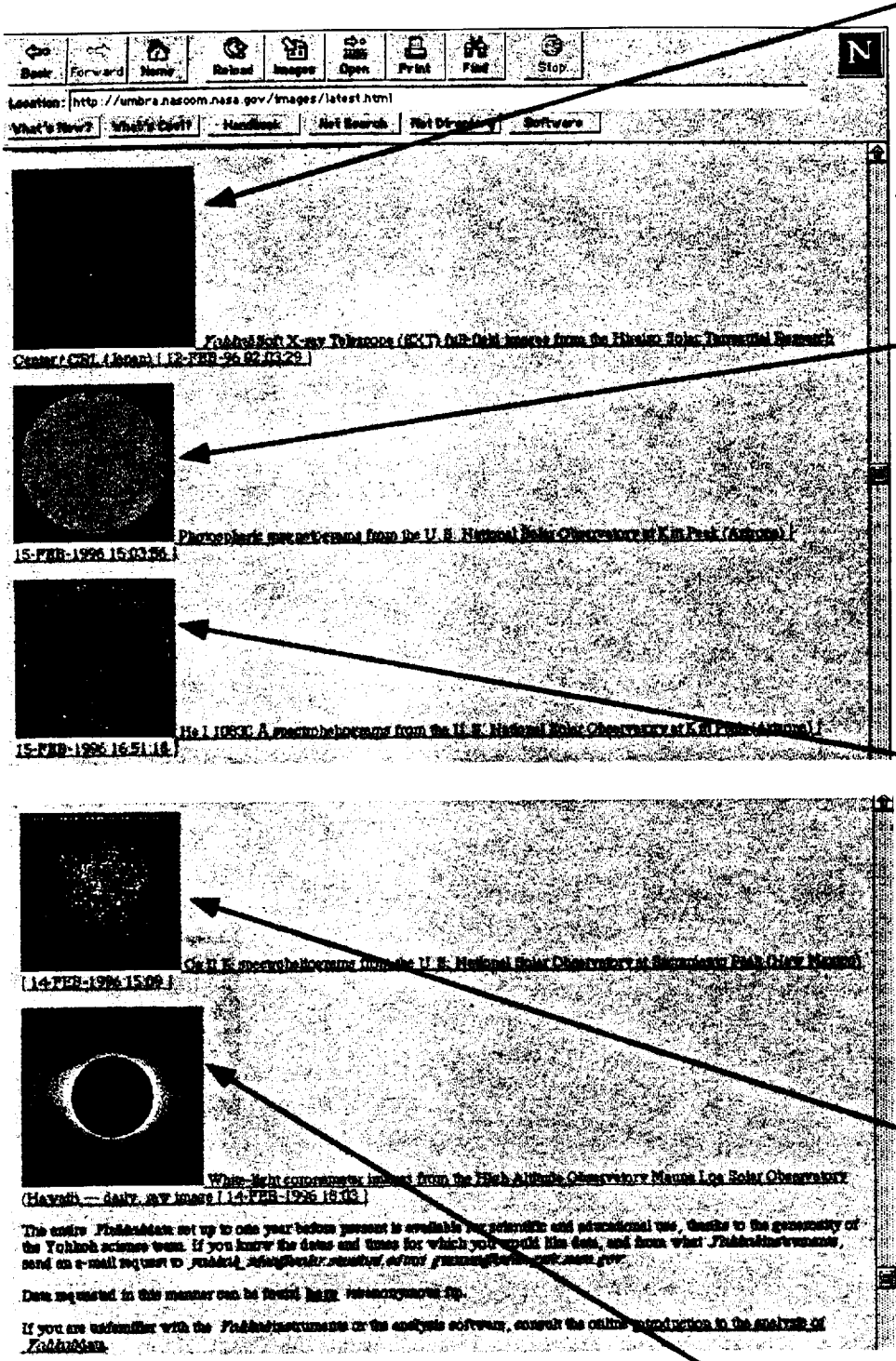
Extreme ultraviolet emissions come from regions of the sun at extremely high temperatures - the chromosphere (just above the sun's visible surface) and the corona (the sun's outermost layer).

Mystery of the SolarTransition Region

One of the current solar mysteries is how the corona is able to maintain extremely high temperatures (> 1 million K) while the chromosphere (seperated from the corona by only a thin transition region) has a temperature that is 100 times cooler. This question is one major focus of the SOHO mission. The images on the left are of spectral lines that form in thin altitude ranges within the transition region. Using these images, scientists hope to understand the structure of this layer separating the chromosphere and corona.

In addition to exploring the transition region, these images can provide other important information. The third image shows emissions from Fe XV (14 times ionized iron) which forms at temperatures found in the corona. Million degree coronal loops, when they occur, are visible at this wavelength.

The fourth image is in HeII 304 Å, which forms at temperatures of ~80,000 K. Such temperatures occur in solar eruptions and coronal loops, making these structures easily visible.



http://umbra.nascom.nasa.gov /images/latest.html

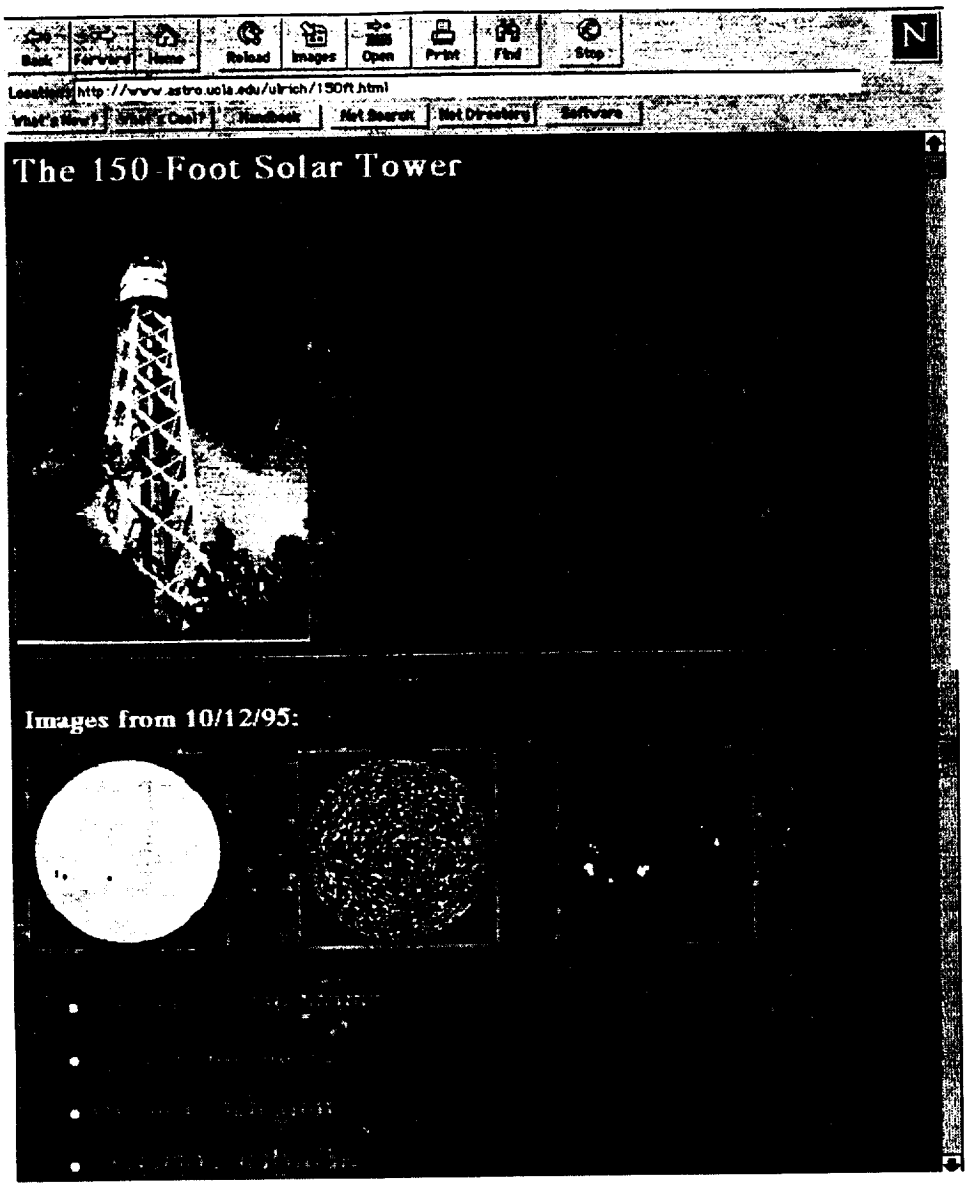
Soft xrays reveal the presence of very hot gases (>2 million K). Because solar flares and active regions heat the gas to extremely high temperatures, these structures appear clearly in soft xrays images. The rest of the sun is dark, since its temperature is much lower.

This is a solar magnetogram which shows the polarity and surface distribution of the sun's magnetism. Dark regions have south polarity, bright regions north polarity. Sunspots usually appear in groups of two with opposite polarity. Polarity reverses when moving from the sun's northern to southern hemisphere.

Information about the sun's corona (outermost layer) can be inferred from He 10830 emission. Active regions and prominences appear black, coronal holes (sometimes associated with recurrent magnetic storms at the Earth) appear light.

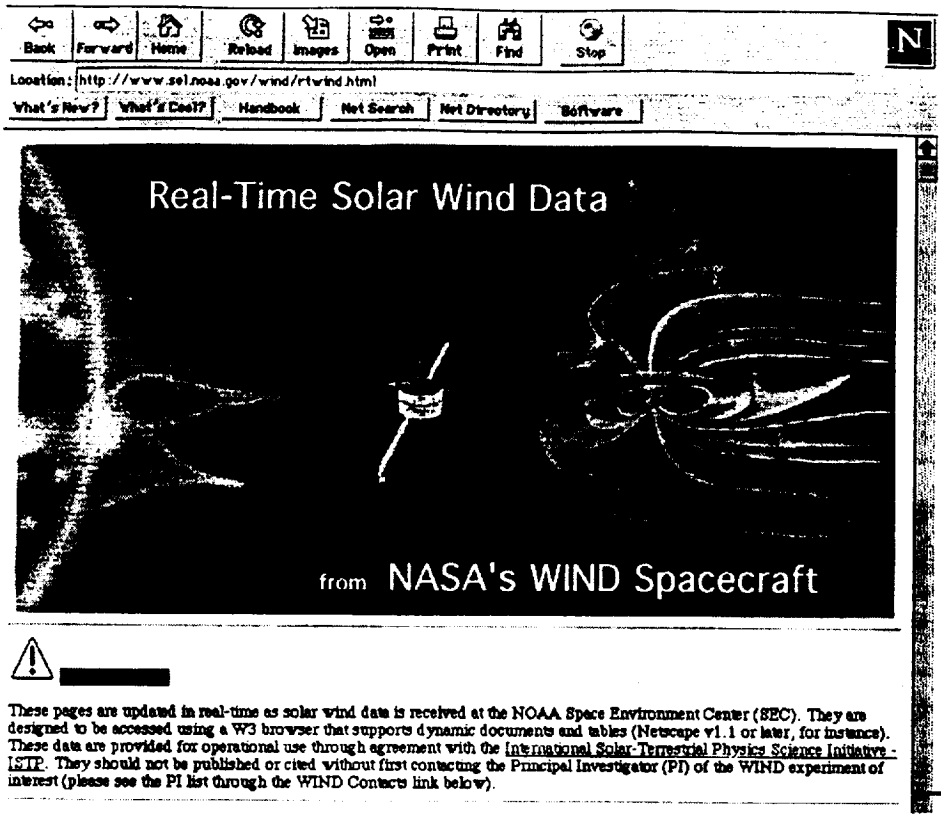
Images the chromosphere (shell of gas several thousand kilometers thick above the sun's visible surface). This emission clearly outlines the boundaries of supergranules (large convection cells) that extend into the chromosphere from the underlying photosphere (sun's visible surface.

This is an image of the corona taken after blocking out the sun's visible face with an occulting disk. Features which may appear include giant expanding bubbles called coronal transients and coronal mass ejections sometimes associated with magnetic storm on Earth.



Solar Images from the 150 Foot Solar Tower

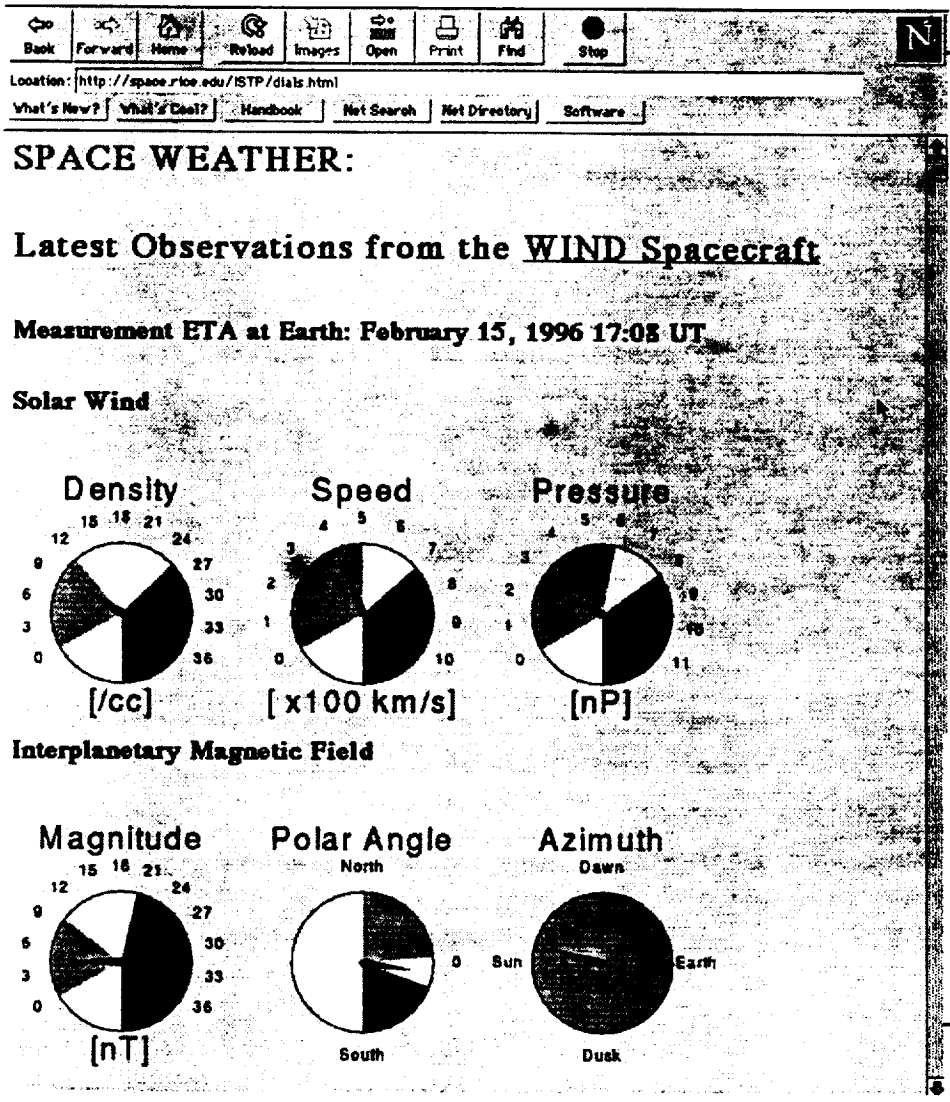
http://www.astro.ucla.edu /ulrich/150ft.html



Real-Time Solar Wind Data

The great Greek philosopher Heracleitus once said you can never step in the same river twice because the river is continuously changing as it flows by you. Like the river, the solar wind changes speed, density and structure in an ever-evolving outward flow. The solar wind is formed as the sun's topmost layer, the corona, blows outward into space. The interaction between the solar wind and the Earth's magnetosphere is responsible for triggering magnetic storms.

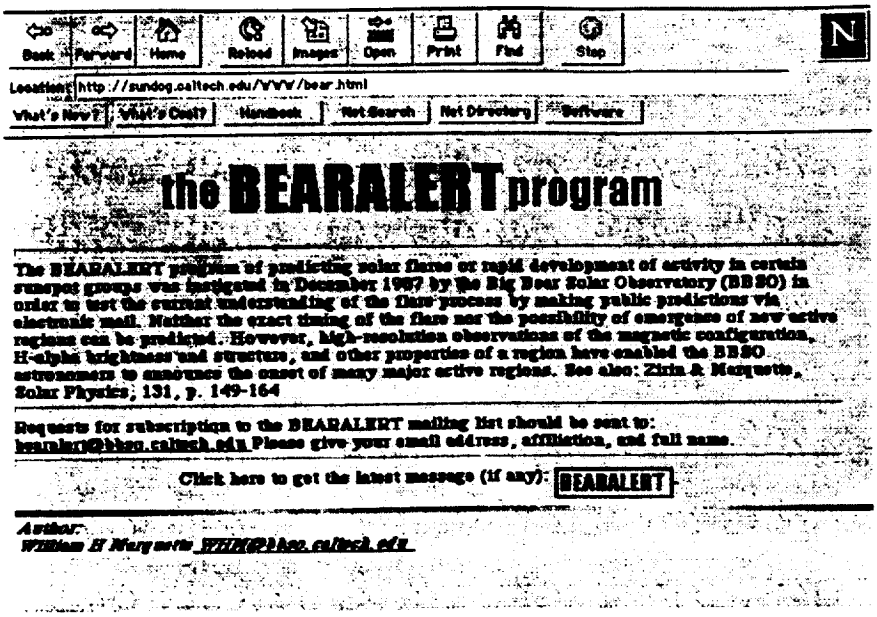
http://www.sel.noaa.gov /wind/rtwind.html



At this web site, maintained by Rice University, the solar wind information, returned by the WIND spacecraft, is displayed on a series of dials. In the first row, the solar wind density, speed and pressure are indicated. Average solar wind densities are ~3-10 particles/cc. Average speed is ~400 km/s. However, in high speed streams, velocities can reach or exceed 600-1000 km/s. In the next line of plots, the magnetic field embedded in the solar wind flow is displayed. Average magnetic fields are ~6 nT but can reach 20-30 nT. Southward interplanetary magnetic field values are associated with the development of geomagnetic storms.

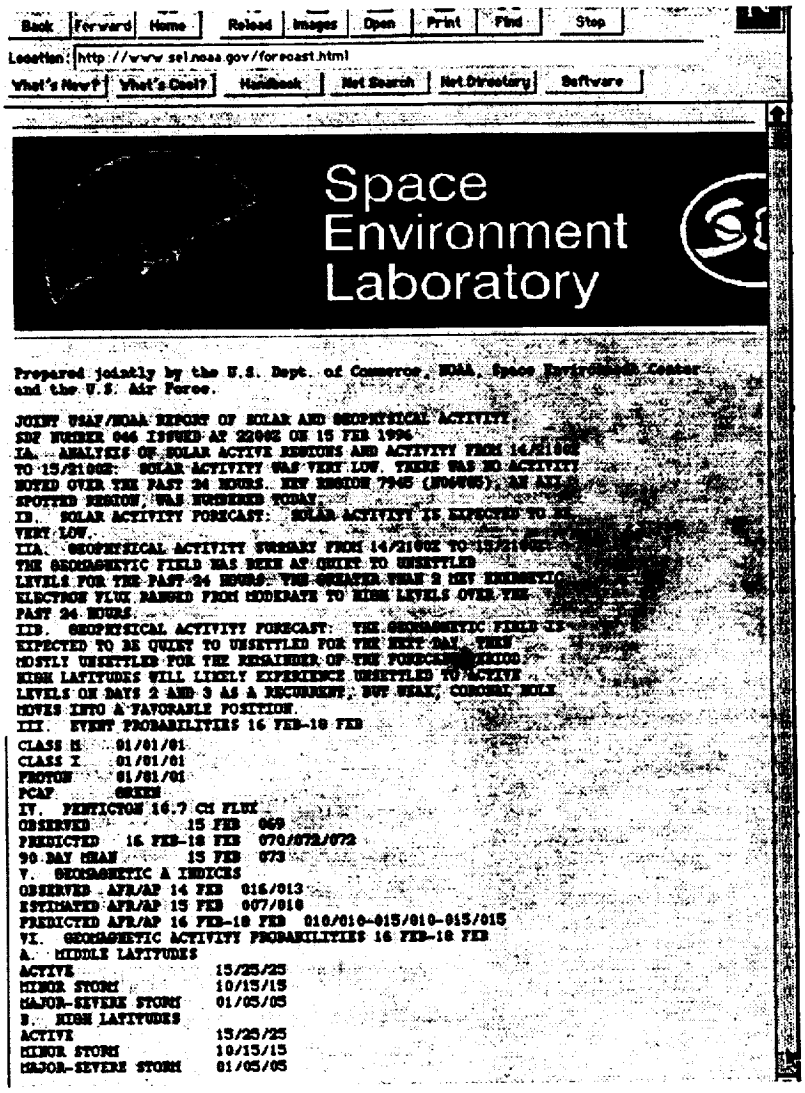
http://space.rice.edu /ISTP/dials.html

Space Weather Forecasting Services



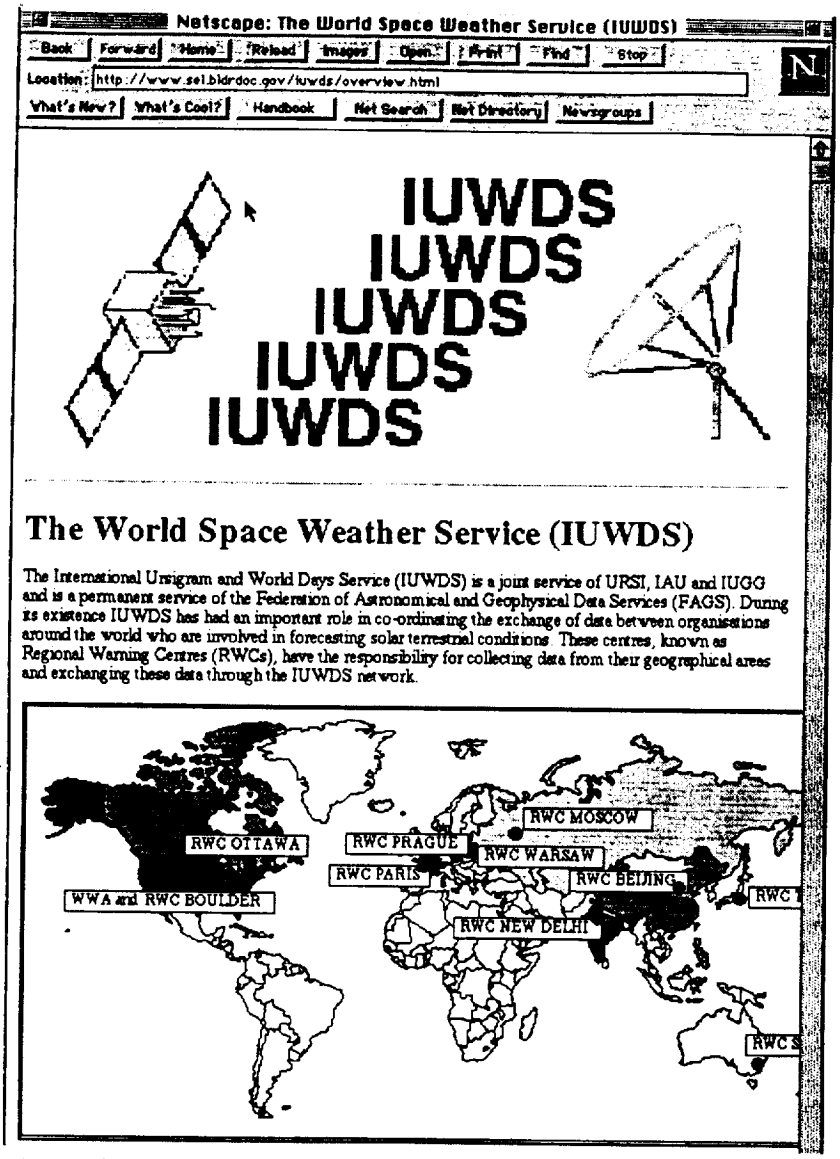
Predictions by the Big Bear Solar Observatory of impending solar flares and the development of active regions on the sun.

http://sundog.caltech.edu /WWW/bear.html



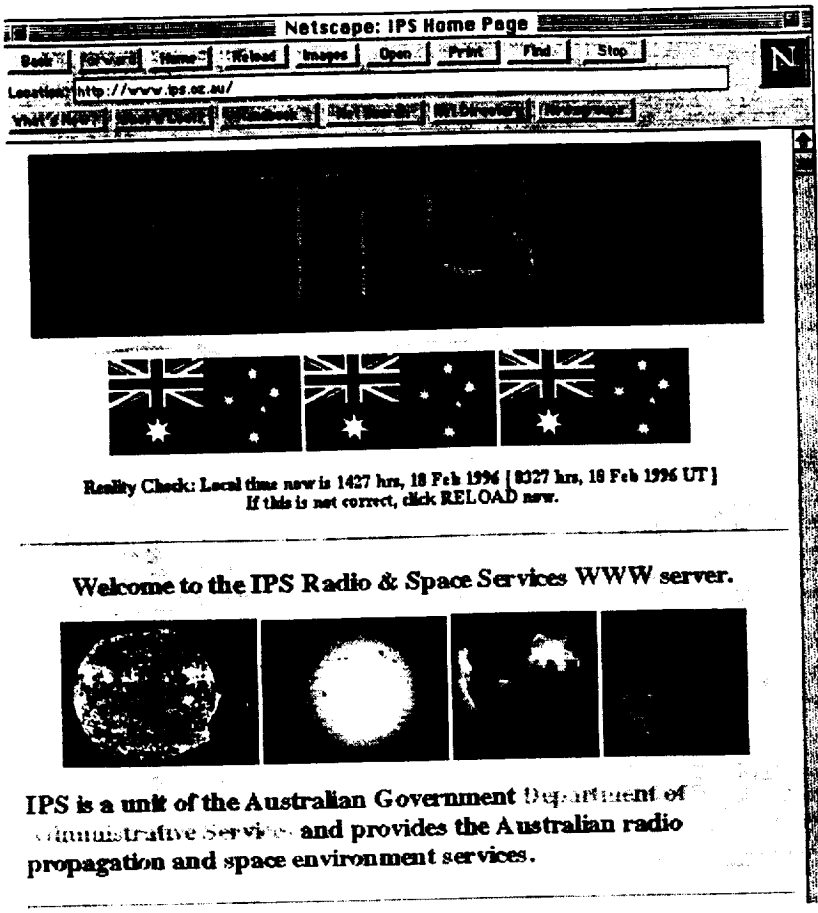
Daily forecasts of solar activity and of the occurrence probability and magnitude of associated geomagnetic storms.

http://www.sel.noaa.gov /forecast.html



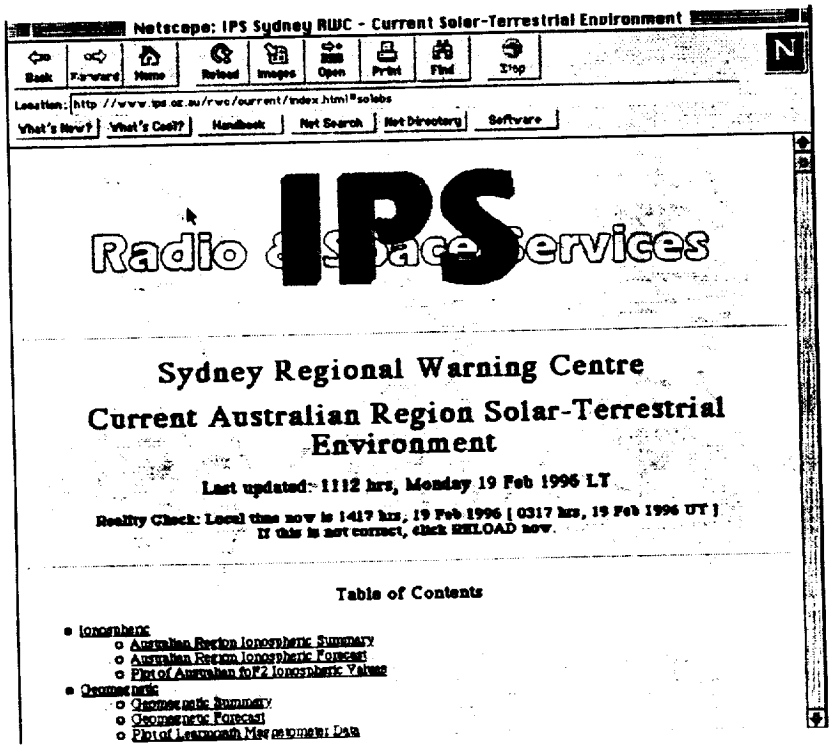
Information on the nature of and services provided by the World Space Weather Service can be found at this site.The world's real-time space weather services are provided by ten Regional Warning Centers (RWC's) listed within this site. These centers are responsible for monitoring solar conditions and predicting solar-terrestrial activity.

http://www.sel.bldrdoc.gov /iuwds/overview.html



Web site of the Sydney, Australia Regional Warning Center. provides a long list of services for commercial and other users whose activities make them vulnerable to space weather effects. Contained in this site is an extensive library of space weather information including web pages detailing the impacts of space weather events on technologies.

http://www.ips.oz.au/



http://www.ips.oz.au/rwc /current/index.html#solobs

Netscape: IPS Sydney RWC - Current Solar-Terrestrial Environment

Location: http://www.ips.oz.au/rwc/current/index.html#solobs

Geomagnetic

Geomagnetic Summary

Last updated 1112 hrs, Monday 19 Feb 1996 LT

Geomagnetic field at Learmonth: Quiet to unsettled

Estimated Indices :	A	K	Observed A Index 17 Feb
Learmonth	10	2223 3322	
Fredericksburg	5		8
Planetary	6		7

Observed Kp for 17 Feb: 3322 1122

Geomagnetic Forecast

Last updated 1112 hrs, Monday 19 Feb 1996 LT

Date	Ap	Conditions
19 Feb	8	Quiet to unsettled
20 Feb	6	Quiet
21 Feb	6	Quiet

Geomagnetic activity forecast.

Learmonth K-indices

Last updated 1059 hrs, Monday 19 Feb 1996 LT

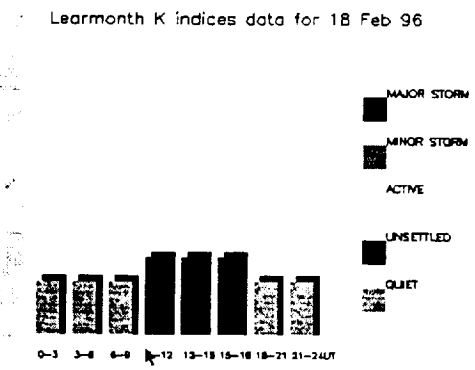


Illustration of the range of values of the K-index associated with difference levels of magnetic activity.

Solar Summary

Last updated 1112 hrs, Monday 19 Feb 1996 LT

Activity: Very low

Flares: None

Observed 10.7 cm flux/Equivalent Sunspot Number : 70/5

GOES satellite data for 17 Feb

Daily Proton Fluence >1 MeV: 9.0E+04
Daily Proton Fluence >10 MeV: 1.7E+04
Daily Electron Fluence >2 MeV: 1.5E+07 (normal)
X-ray background: A1.0

Fluence (flux accumulation over 24hrs)/ cm2-ster-day.

Solar Forecast

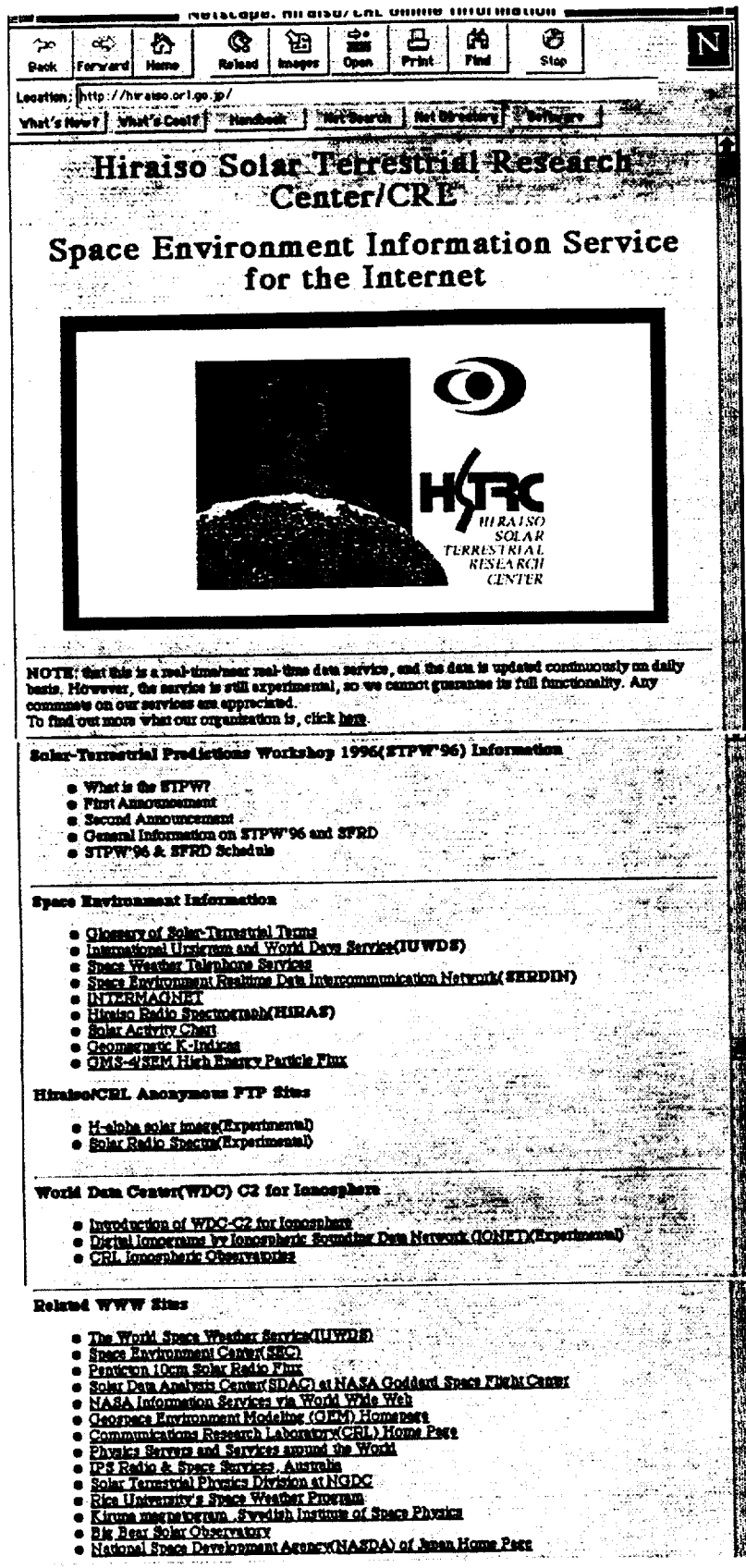
Last updated 1112 hrs, Monday 19 Feb 1996 LT

	19 Feb	20 Feb	21 Feb
Activity	Very low	Very low	Very low
Radiosnts	None expected	None expected	None expected

Forecast 10.7 cm flux/Equivalent Sunspot Number for 19 Feb: 72/8

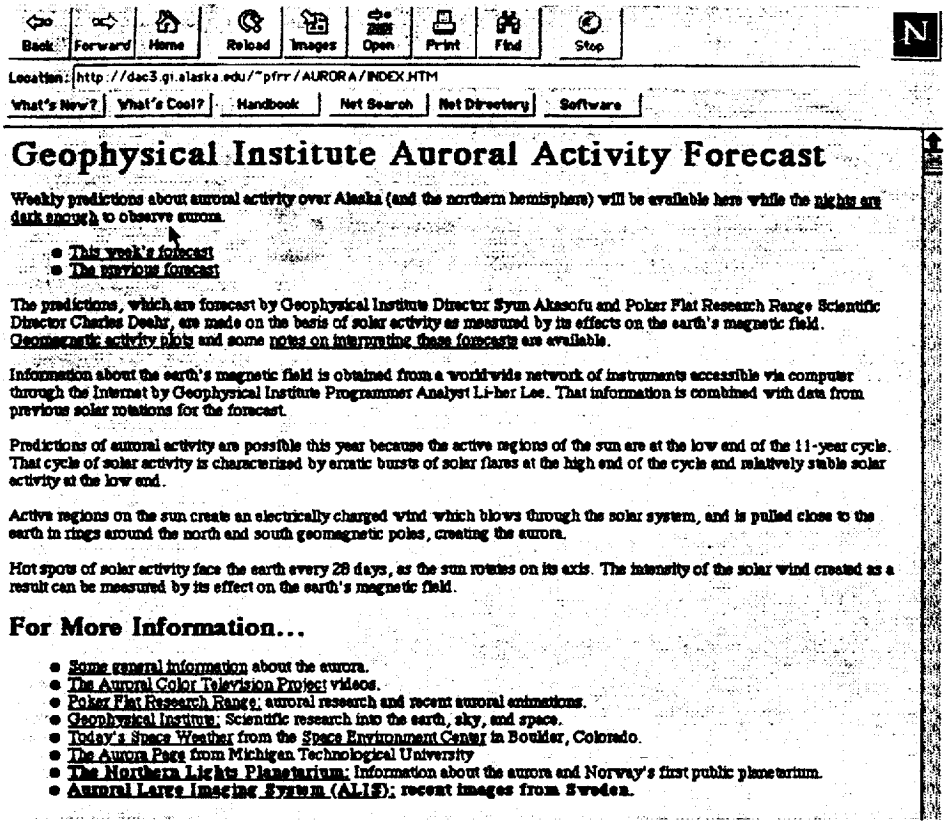
Solar activity forecast.

http://www.ips.oz.au/rwc/current/index.html#solobs



Real-time and near real-time data service for solar, magnetospheric and ionospheric measurements.

http://hiraiso.crl.go.jp/



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Location: http://dac3.gi.alaska.edu/~pfrr/AURORA/INDEX.HTM

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Geophysical Institute Auroral Activity Forecast

Weekly predictions about auroral activity over Alaska (and the northern hemisphere) will be available here while the nights are dark enough to observe aurora.

- This week's forecast
- The previous forecast

The predictions, which are forecast by Geophysical Institute Director Syun Akasofu and Poker Flat Research Range Scientific Director Charles Deehr, are made on the basis of solar activity as measured by its effects on the earth's magnetic field. Geomagnetic activity plots and some notes on interpreting these forecasts are available.

Information about the earth's magnetic field is obtained from a worldwide network of instruments accessible via computer through the Internet by Geophysical Institute Programmer Analyst Li-her Lee. That information is combined with data from previous solar rotations for the forecast.

Predictions of auroral activity are possible this year because the active regions of the sun are at the low end of the 11-year cycle. That cycle of solar activity is characterized by erratic bursts of solar flares at the high end of the cycle and relatively stable solar activity at the low end.

Active regions on the sun create an electrically charged wind which blows through the solar system, and is pulled close to the earth in rings around the north and south geomagnetic poles, creating the aurora.

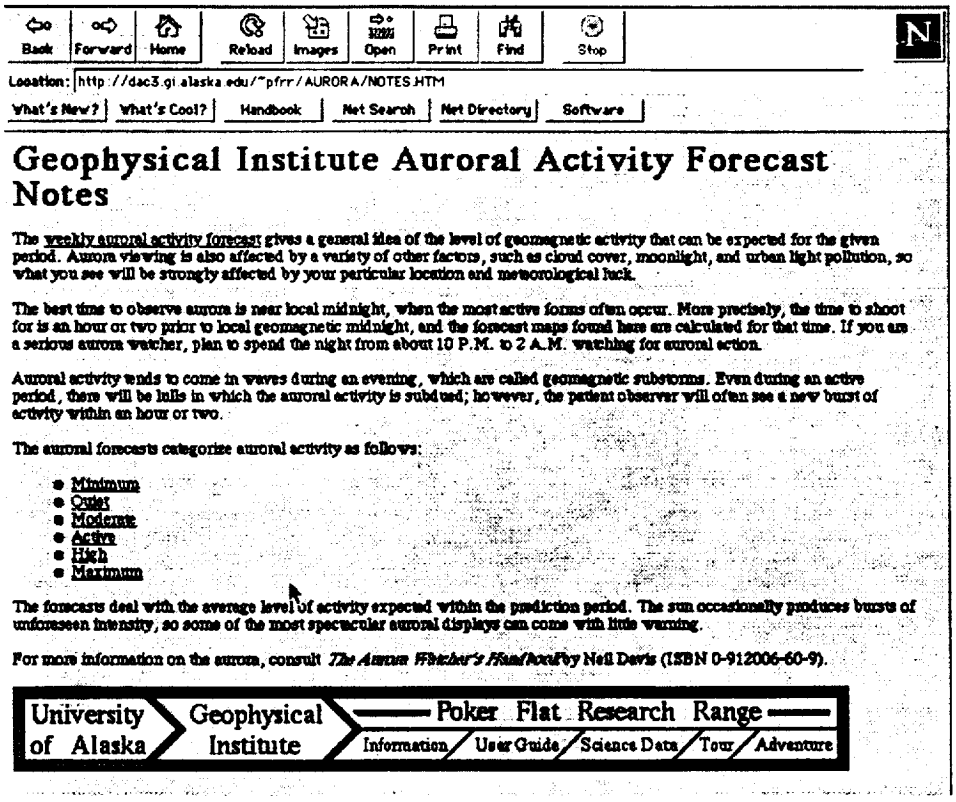
Hot spots of solar activity face the earth every 28 days, as the sun rotates on its axis. The intensity of the solar wind created as a result can be measured by its effect on the earth's magnetic field.

For More Information...

- Some general information about the aurora.
- The Auroral Color Television Project videos.
- Poker Flat Research Range: auroral research and recent auroral eruptions.
- Geophysical Institute: Scientific research into the earth, sky, and space.
- Today's Space Weather from the Space Environment Center in Boulder, Colorado.
- The Aurora Page from Michigan Technological University
- **The Northern Lights Planetarium:** Information about the aurora and Norway's first public planetarium.
- **Auroral Large Imaging System (ALIS): recent images from Sweden.**

Predictions of the location and extent of auroral activity.

http://dac3.gi.alaska.edu /~pfrr/AURORA/INDEX.HTM



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Location: http://dac3.gi.alaska.edu/~pfrr/AURORA/NOTES.HTM

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Geophysical Institute Auroral Activity Forecast Notes

The weekly auroral activity forecast gives a general idea of the level of geomagnetic activity that can be expected for the given period. Aurora viewing is also affected by a variety of other factors, such as cloud cover, moonlight, and urban light pollution, so what you see will be strongly affected by your particular location and meteorological luck.

The best time to observe aurora is near local midnight, when the most active forms often occur. More precisely, the time to shoot for is an hour or two prior to local geomagnetic midnight, and the forecast maps found here are calculated for that time. If you are a serious aurora watcher, plan to spend the night from about 10 P.M. to 2 A.M. watching for auroral action.

Auroral activity tends to come in waves during an evening, which are called geomagnetic substorms. Even during an active period, there will be lulls in which the auroral activity is subdued; however, the patient observer will often see a new burst of activity within an hour or two.

The auroral forecasts categorize auroral activity as follows:

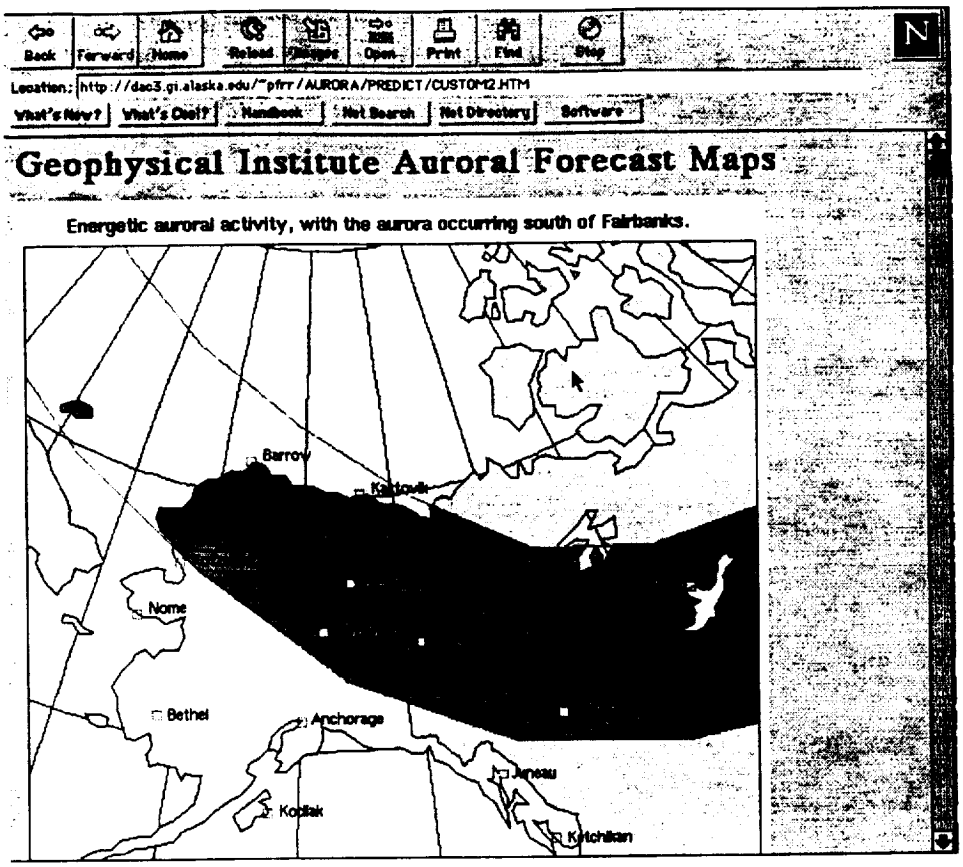
- Minimum
- Quiet
- Moderate
- Active
- High
- Maximum

The forecasts deal with the average level of activity expected within the prediction period. The sun occasionally produces bursts of unforeseen intensity, so some of the most spectacular auroral displays can come with little warning.

For more information on the aurora, consult *The Aurora Watcher's Handbook* by Neil Davis (ISBN 0-912006-60-9).

University of Alaska | Geophysical Institute | Poker Flat Research Range — Information / User Guide / Science Data / Tour / Adventure

http://dac3.gi.alaska.edu /~pfrr/AURORA/NOTES.HTM

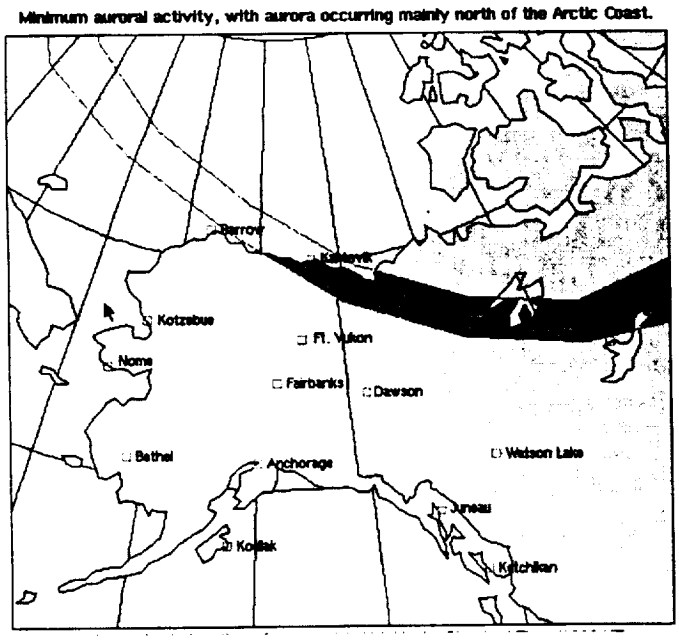


Comparison between the predicted auroral oval and statistical auroral ovals for various activity levels provides a dramatic indicator of the current level of magnetic activity.

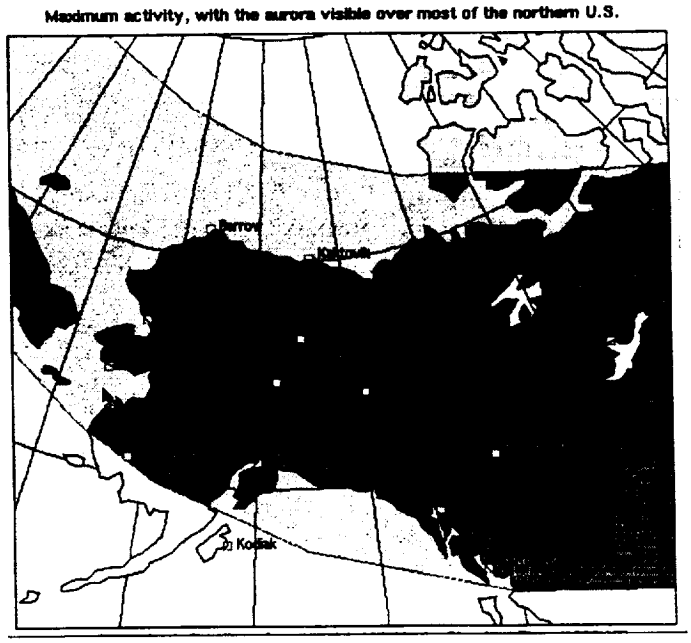
http://dac3.gi.alaska.edu/~pfrr/AURORA/PREDICT/CUSTOM2.HTM

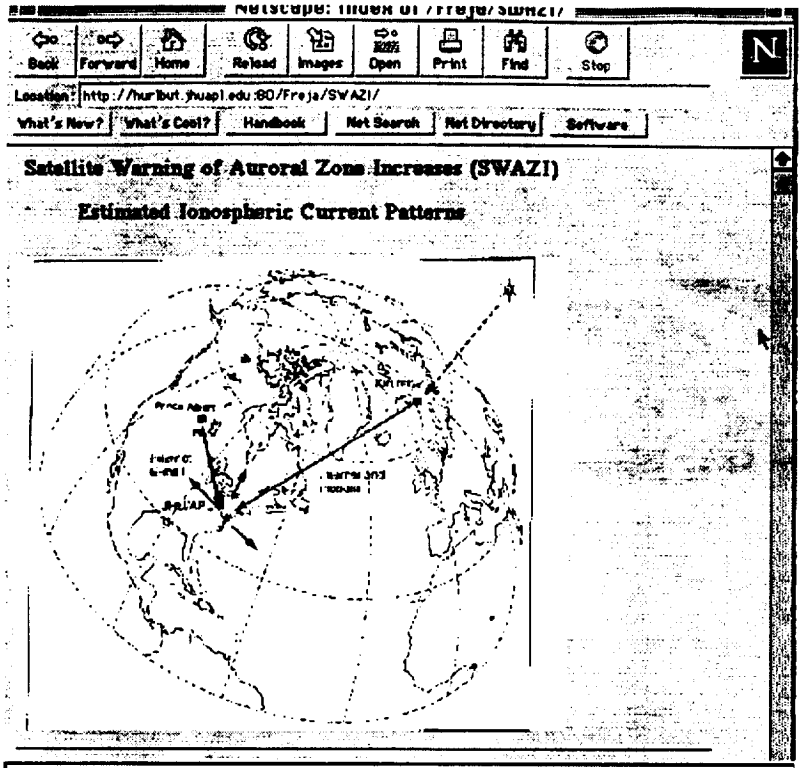
Statistical Auroral Oval Maps

Low Magnetic Activity



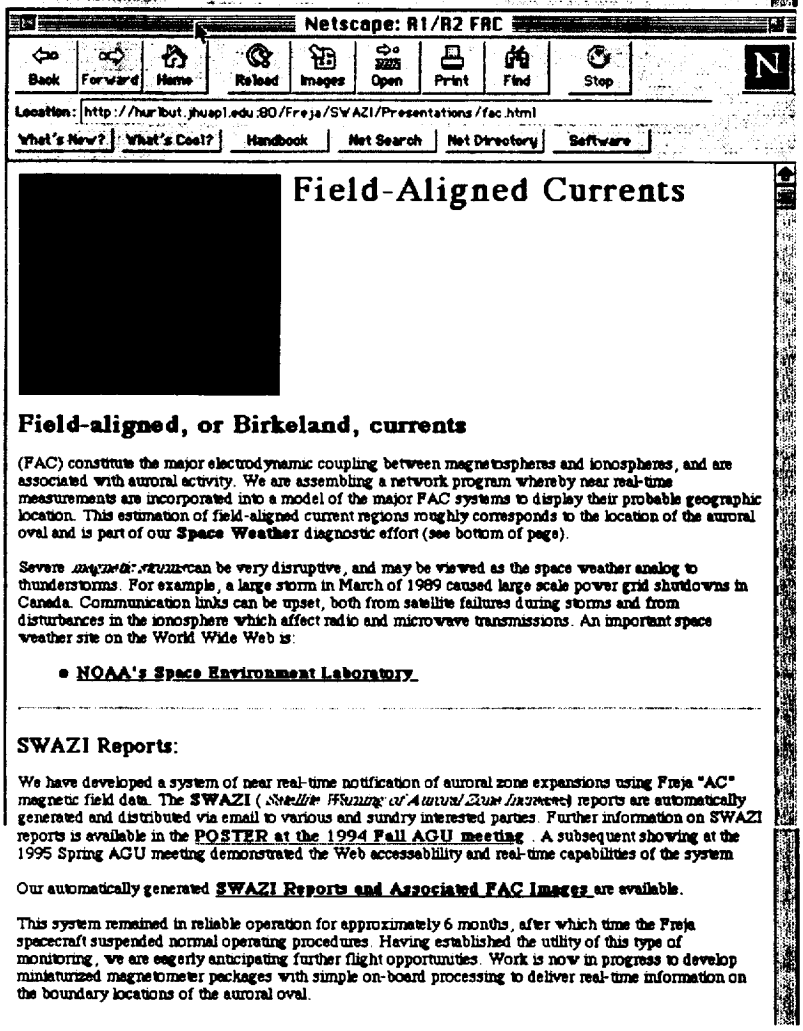
High Magnetic Activity



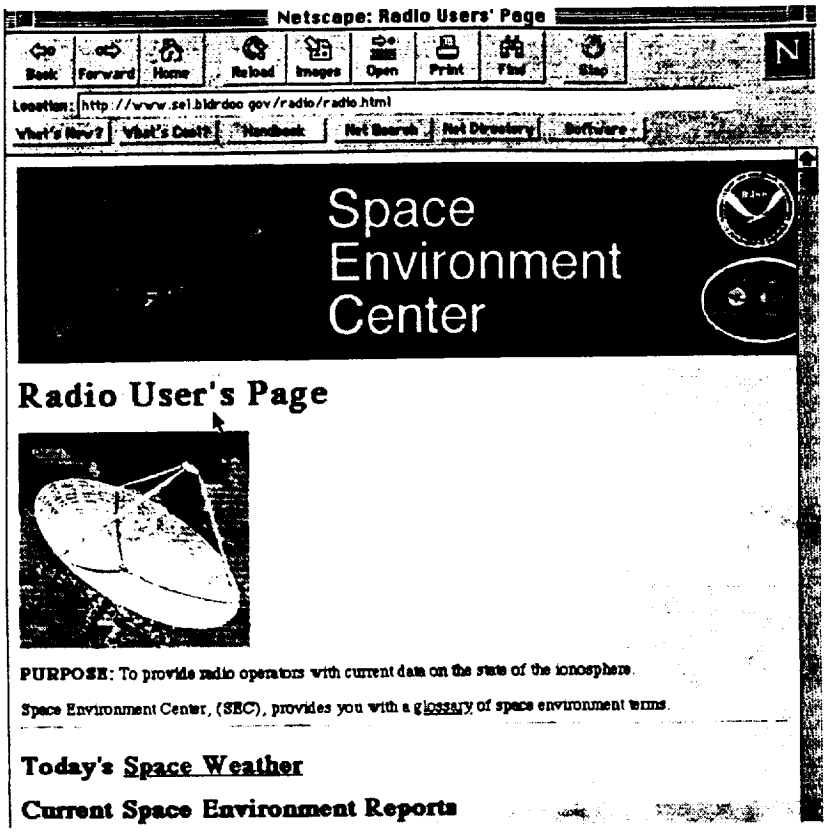


Field tested method for predicting the location and extent of the auroral oval. Description of the method given along with examples of its past use.

http://hurlbut.jhuapl.edu:80 /Freja/SWAZI/



http://hurlbut.jhuapl.edu:80 /Freja/SWAZI/Presentations /fac.html



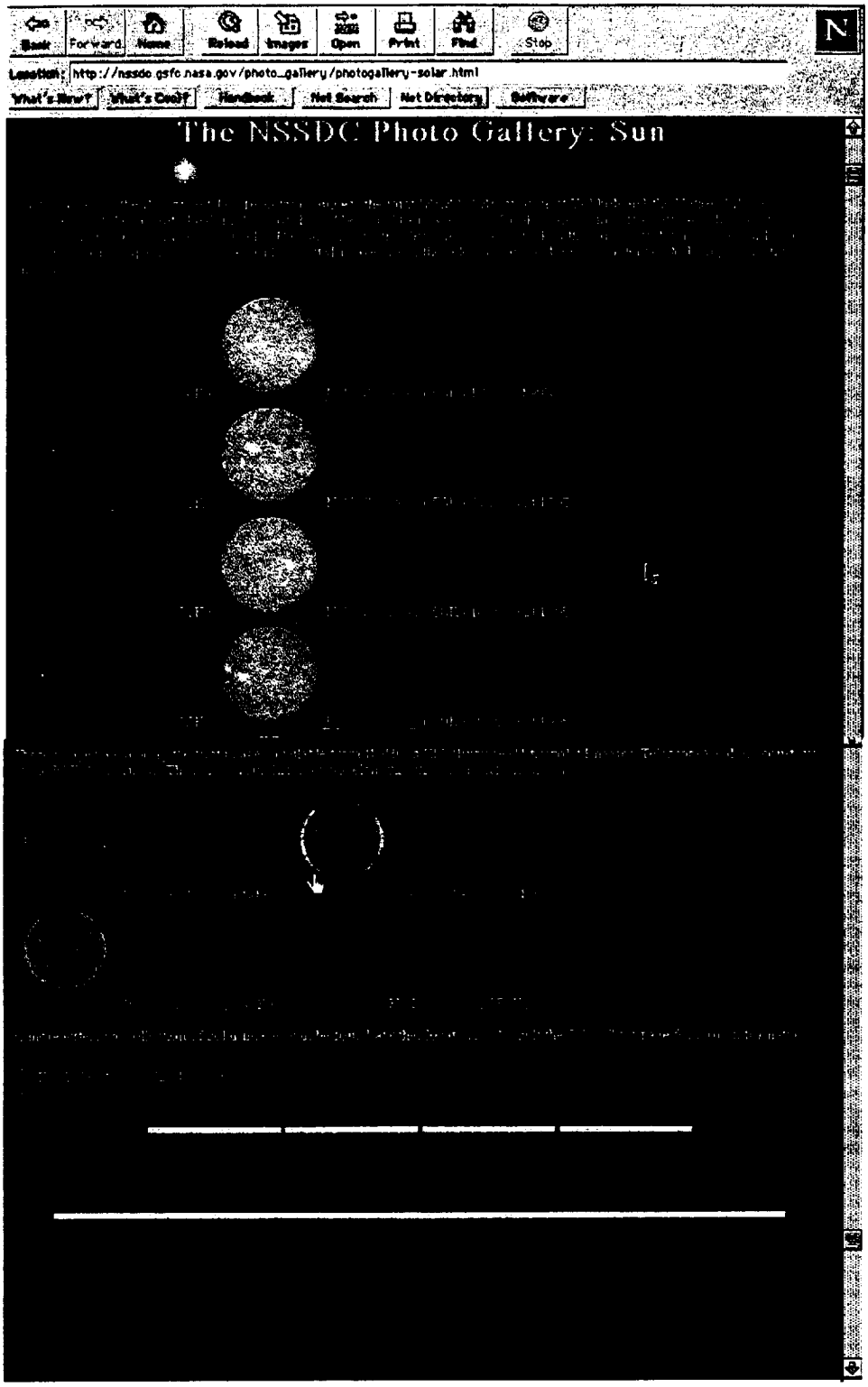
One major impact of geomagnetic activity is disruption of radio communications. On this page are forecasting sites for radio users. More are contained in the IPS web pages (see page 33 in this guide).

http://www/sel/bldrdoc.gov /radio/radio.html

http://solar.uleth.ca /solar/www/realtime.html

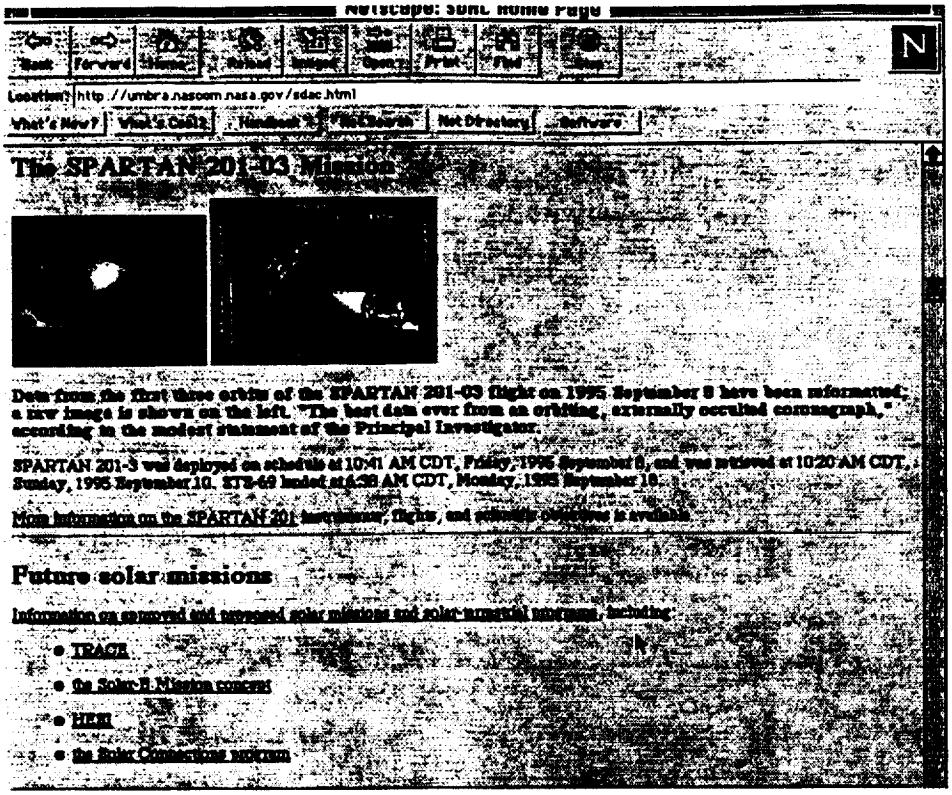
Space Physics Data Bases and Photo Galleries of Space Physics-Related Images

The web is fast becoming the most popular means of freely and easily accessing NASA's immense photographic galleries of celestial objects, the sun, planets and other solar system bodies as well as the photographic holdings of other agencies, universities, national observatories and international centers.



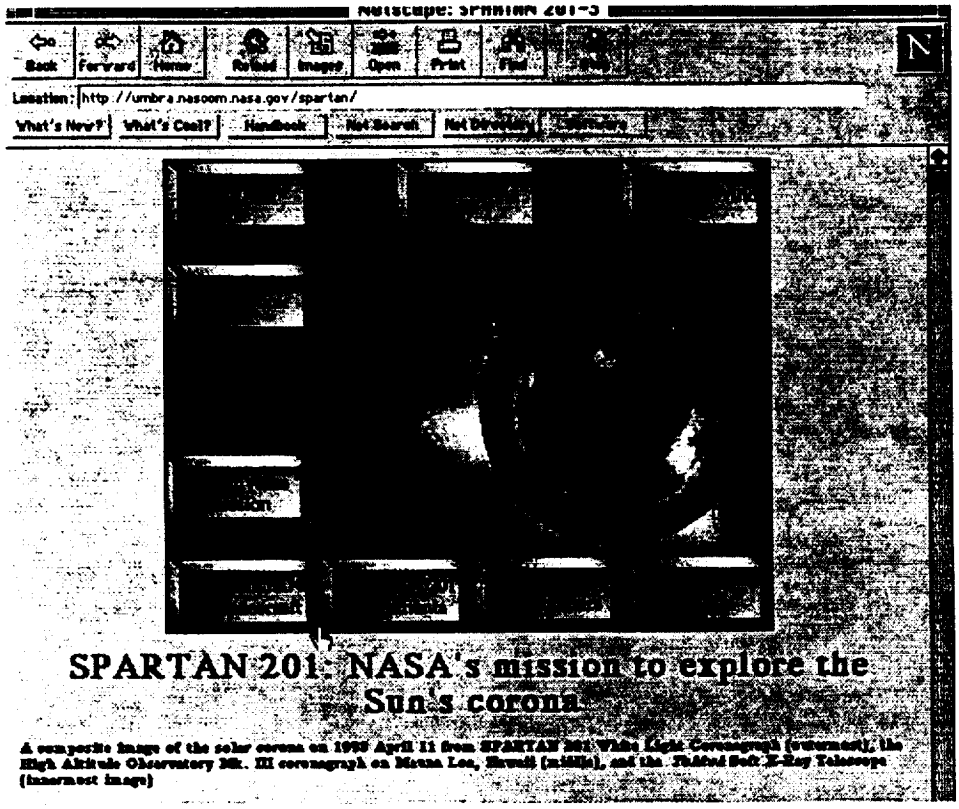
Without a doubt, the NSSDC Photo Gallery is one of the most beautiful sites on the web. This subpage contains links to hundreds of images of the sun. The home page of the NSSDC gallery also contains links to images of the planets, stars and galaxies

http://nssdc.gsfc.nasa.gov/photo_gallery/photogallery-solar.html



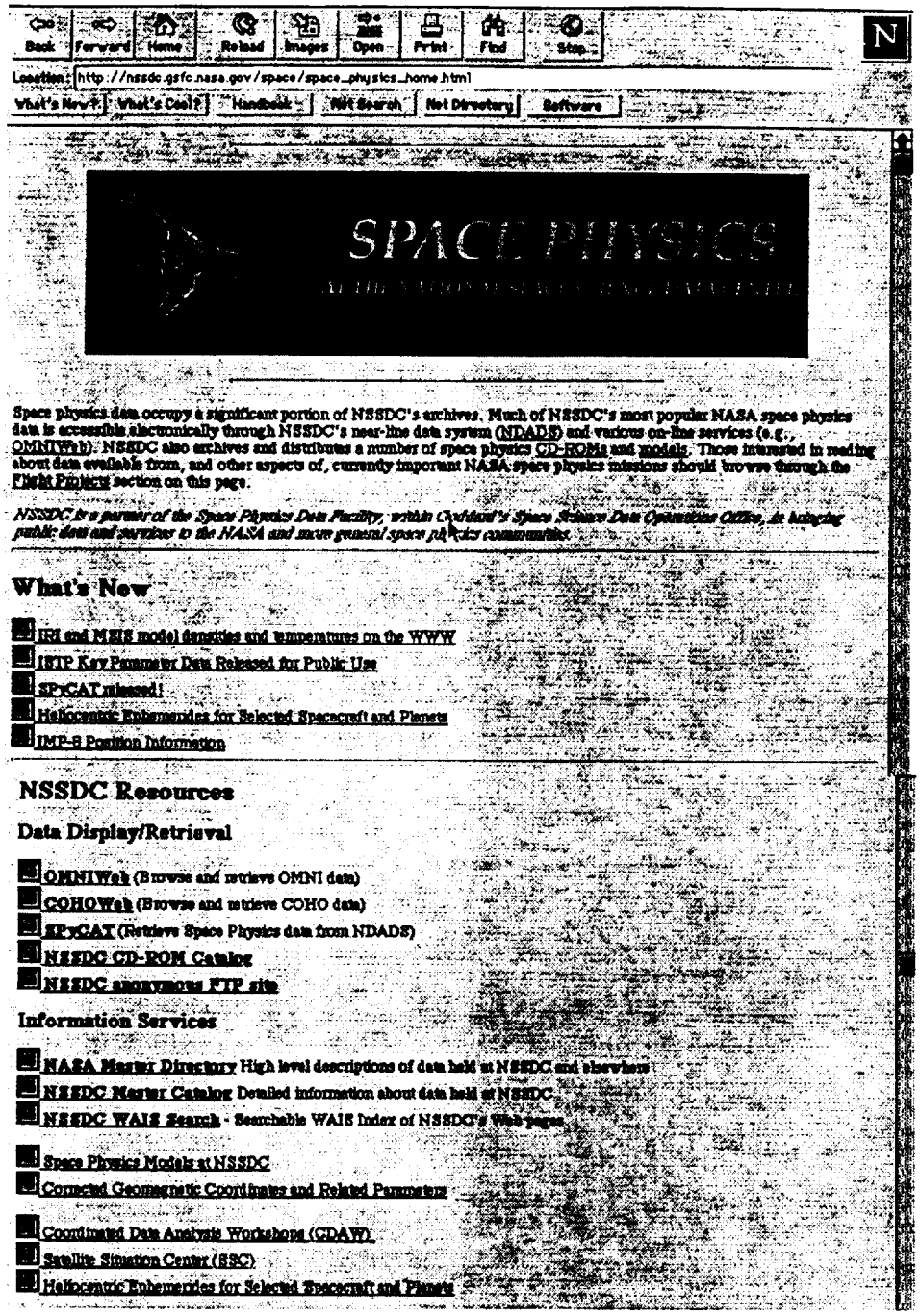
Links provided to images of the corona and the solar wind from the SPARTAN 201-3 data base.

http://umbra.nascom.nasa.gov /sdac.html



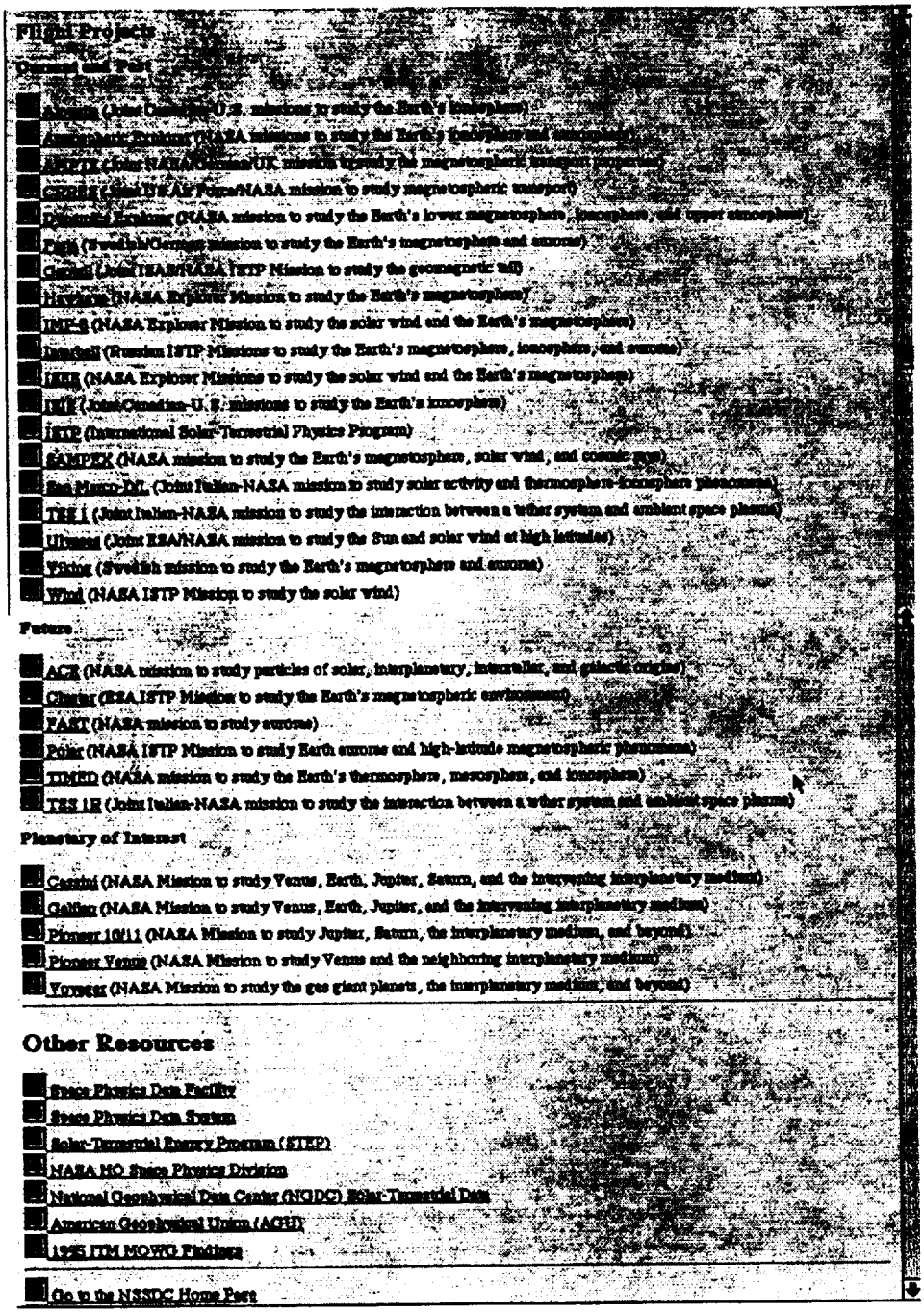
Navigation panel for the Sparton 201-3 web site.

http://umbra.nascom.nasa.gov /spartan/

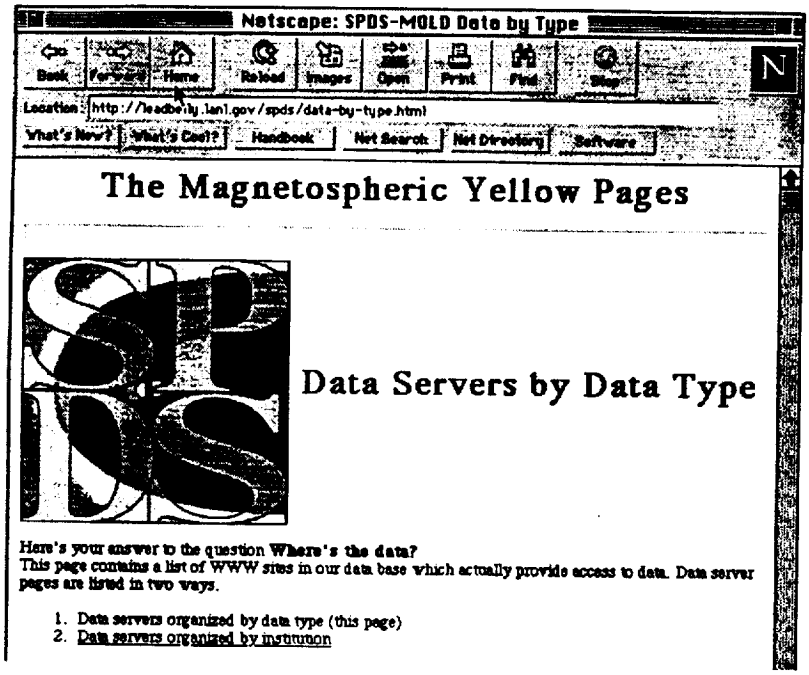


Access to the nation's treasure trove of archived satellite data related to space physics through the NSSDC.

http://nssdc.gsfc.nasa.gov /space/space_physics_home.html

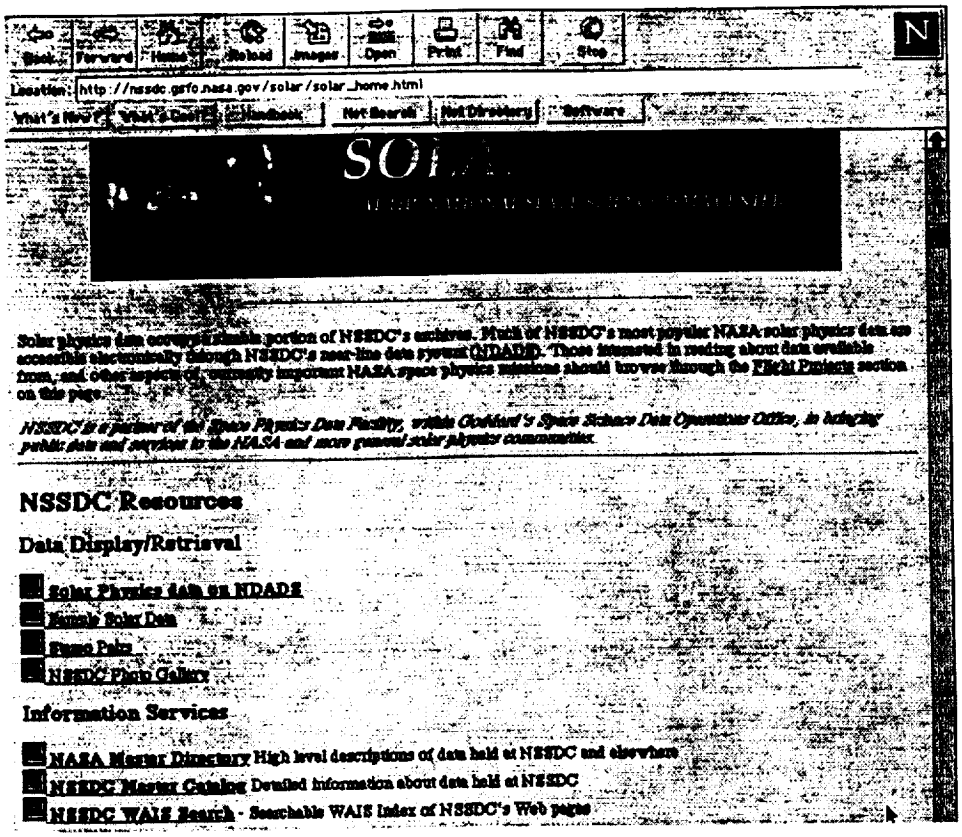


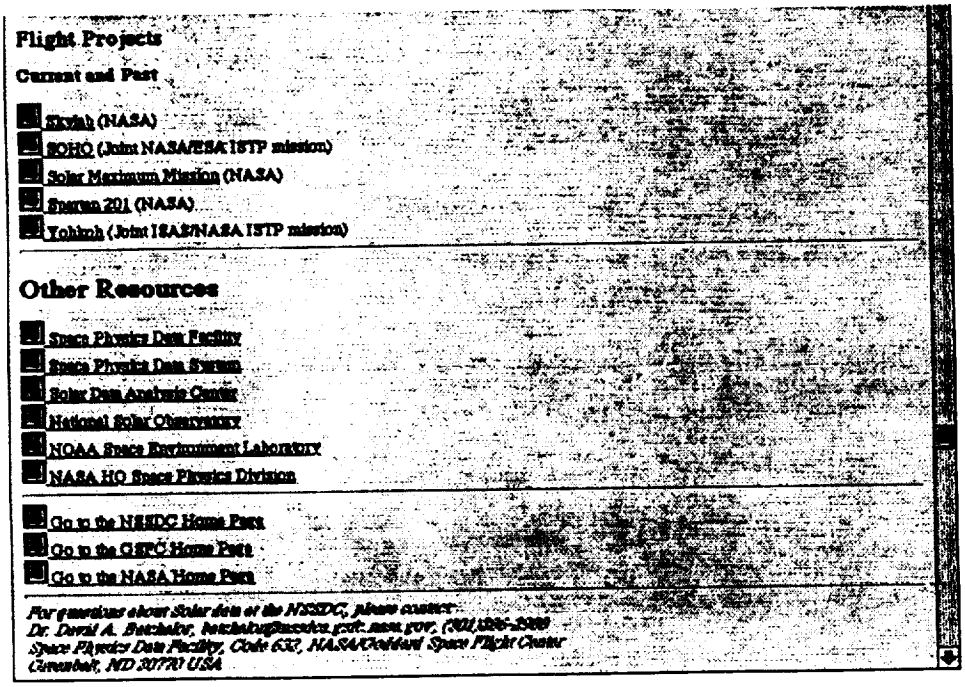
http://nssdc.gsfc.nasa.gov /space/space_physics_home.html



Comprehensive listing of archived space physics data sets by Institution and type of data. Contains helpful descriptions of the resources available at the sites in the reference list to help you to decide which sites to visit.

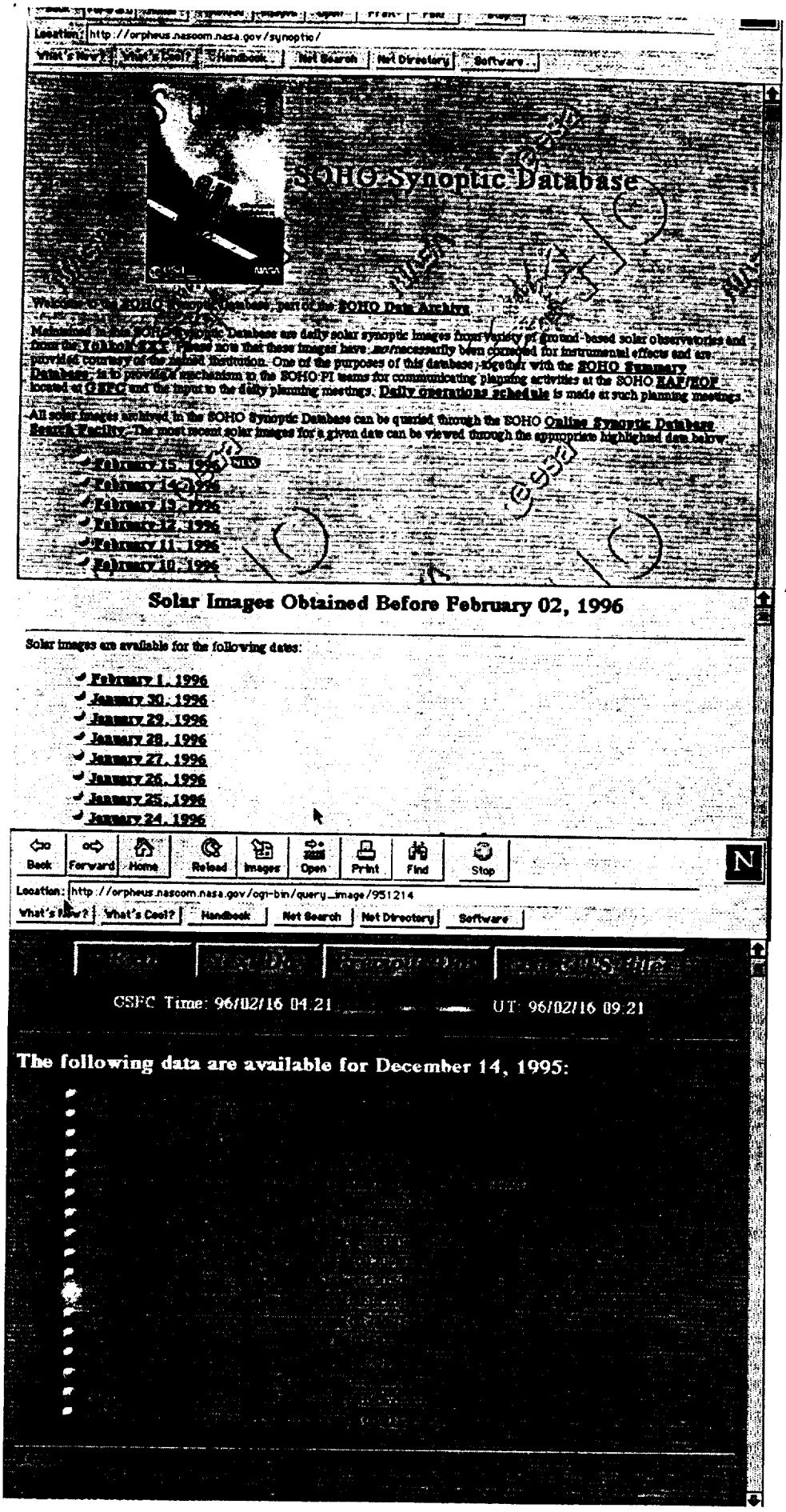
http://leadbelly.lanl.gov /spds/data-by-type.html





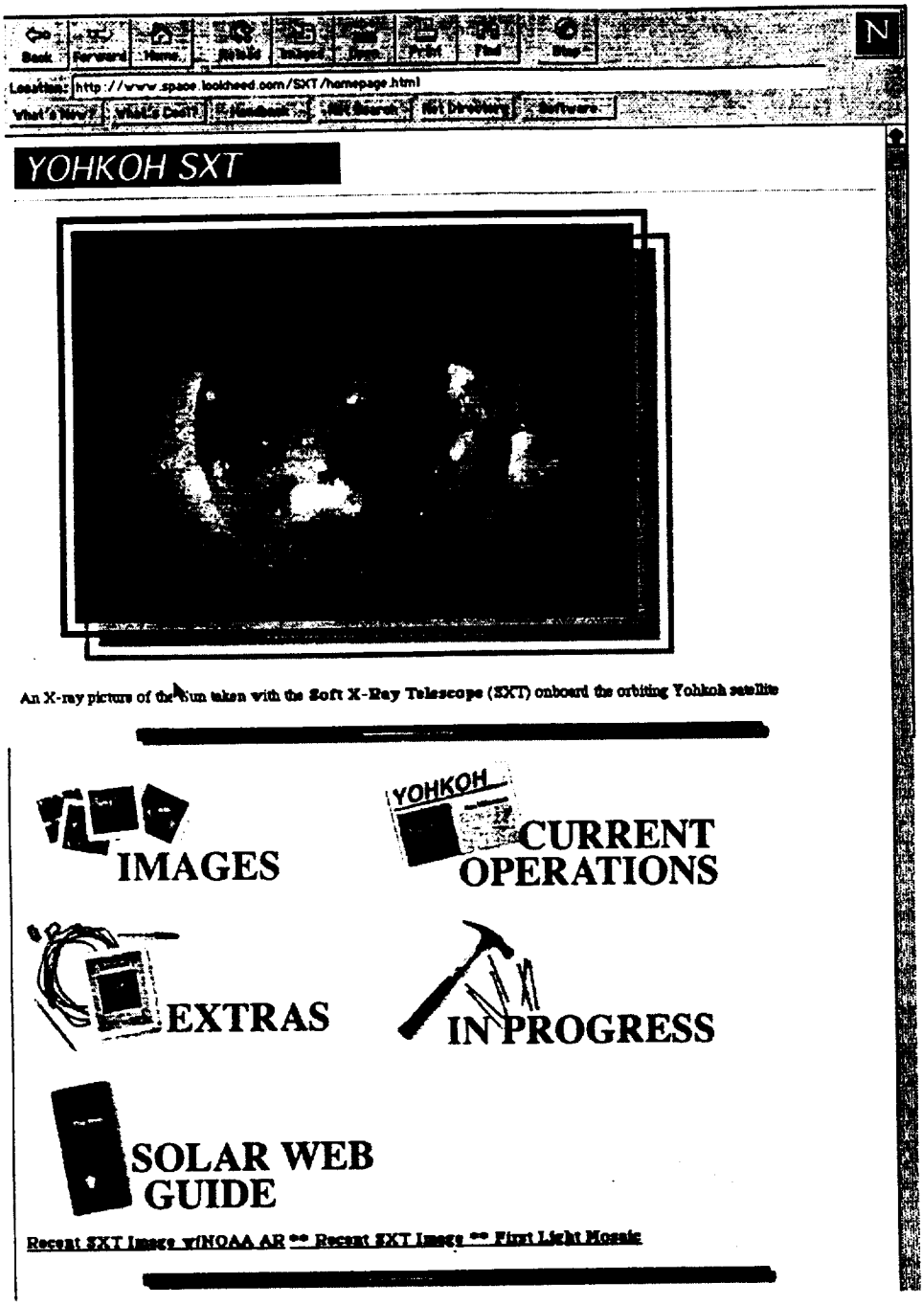
Easy access to the nation's vast storehouse of solar physics data bases held at the NSSDC.

http://nssdc.gsfc.nasa.gov /solar/solar_home.html



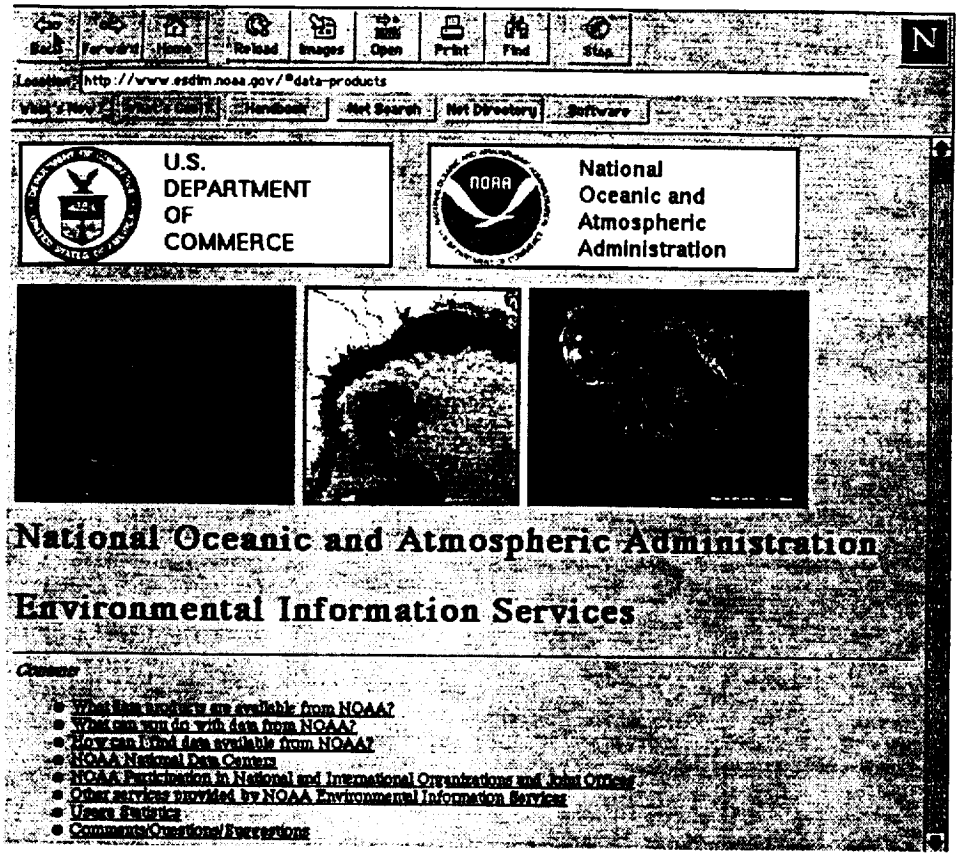
Collected images of the Sun in different wavelengths of light.

http://orpheus.nascom.nasa.gov /synoptic/



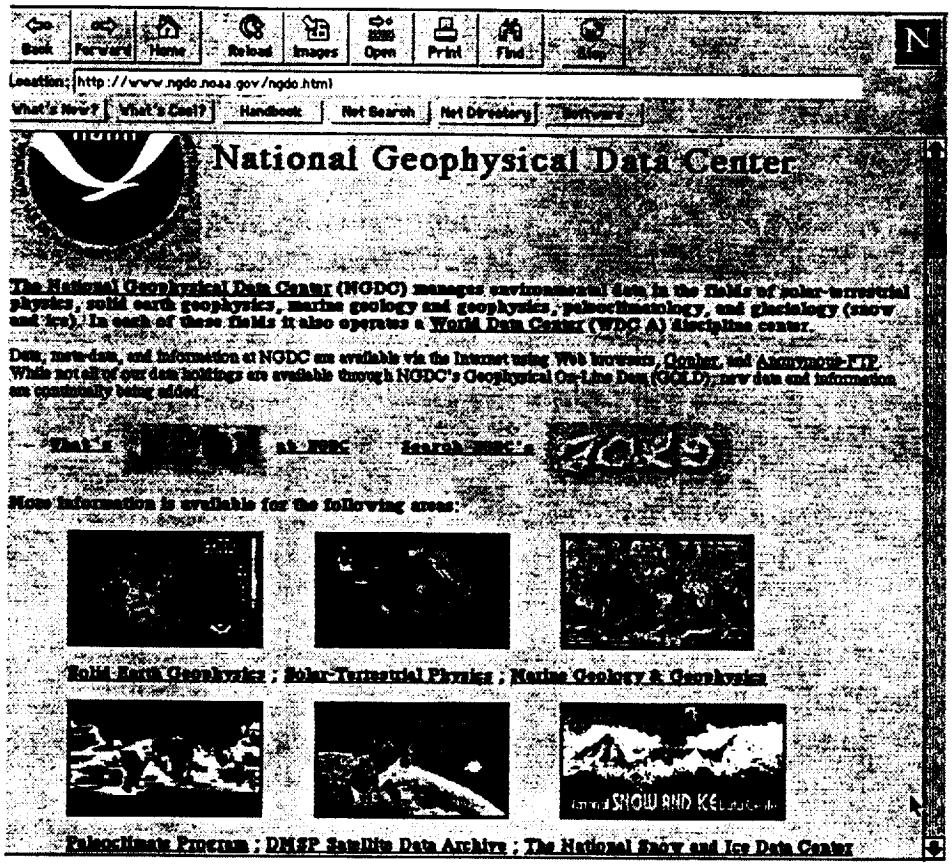
Breathtaking collection of soft x-ray images of the sun taken onboard the Yohkoh spacecraft.

http://www.space.lockheed.com /SXT/homepage.html

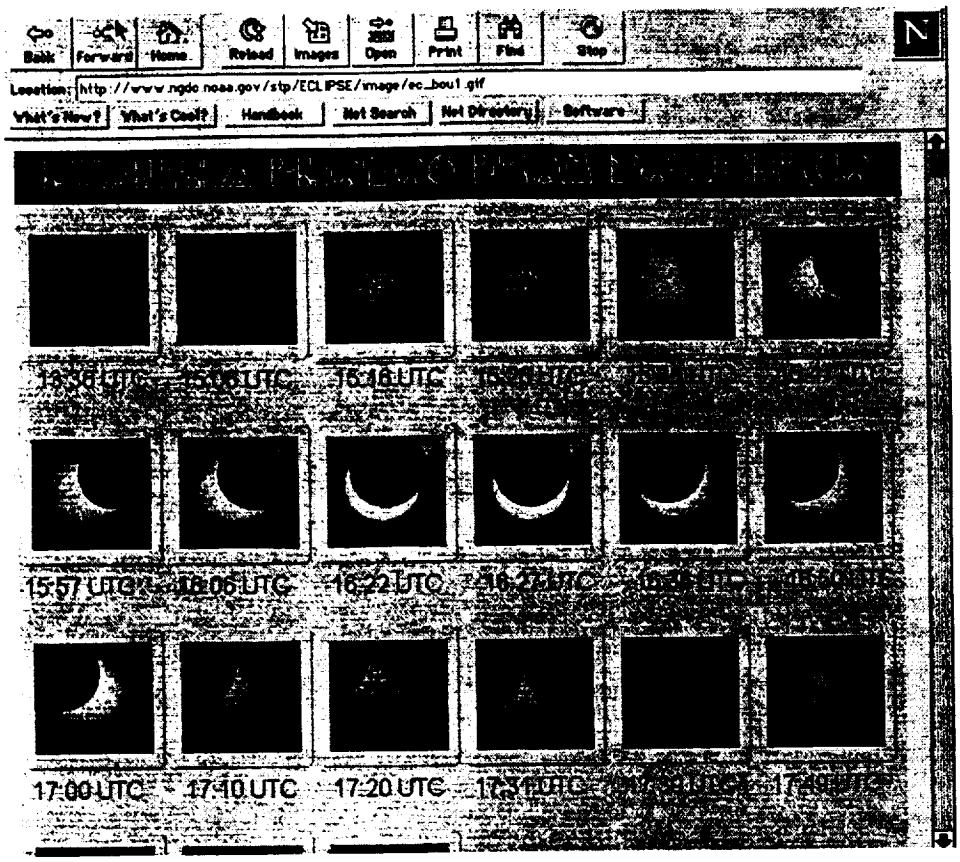


Space weather data resources at NOAA

http://www.esdim.noaa.gov /#data-products



http://www.ngdc.noaa.gov /ngdc.html

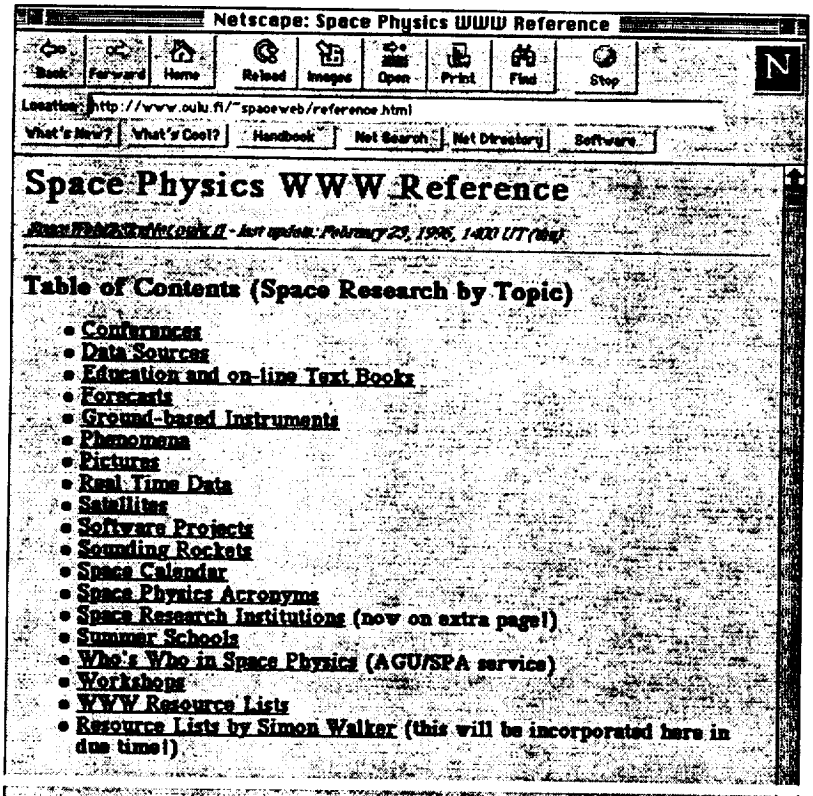


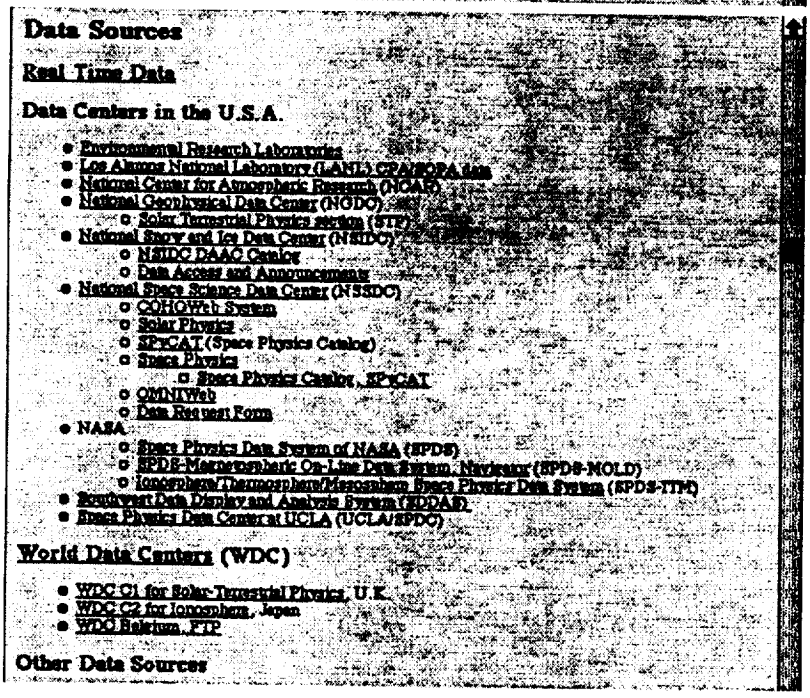
Beautiful solar eclipse sequence from the NOAA archives

http://www.ngdc.noaa.gov/stp/ECLIPSE/image/ec_bou1.gif

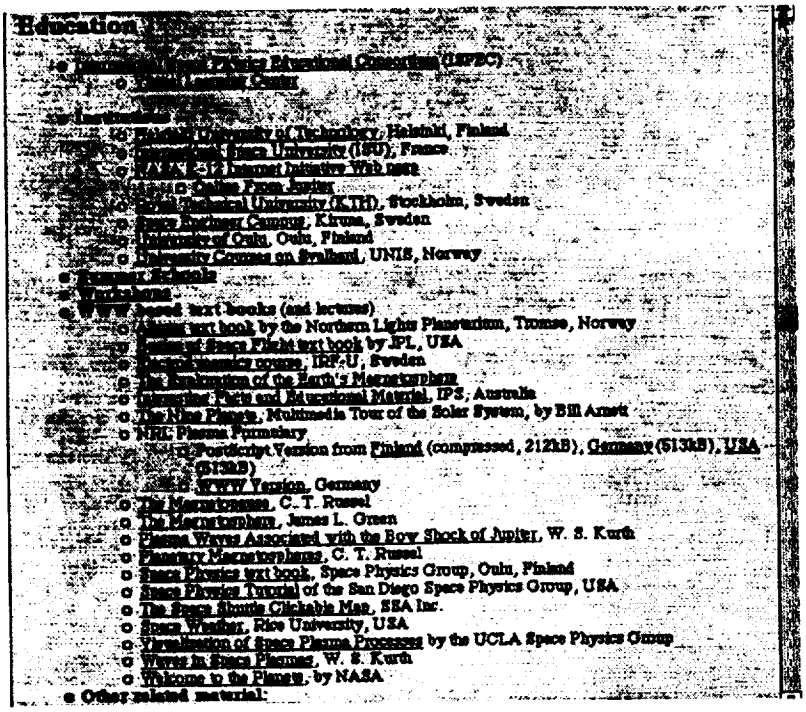
Hot Links to Other Space Weather and Space Physics Sites

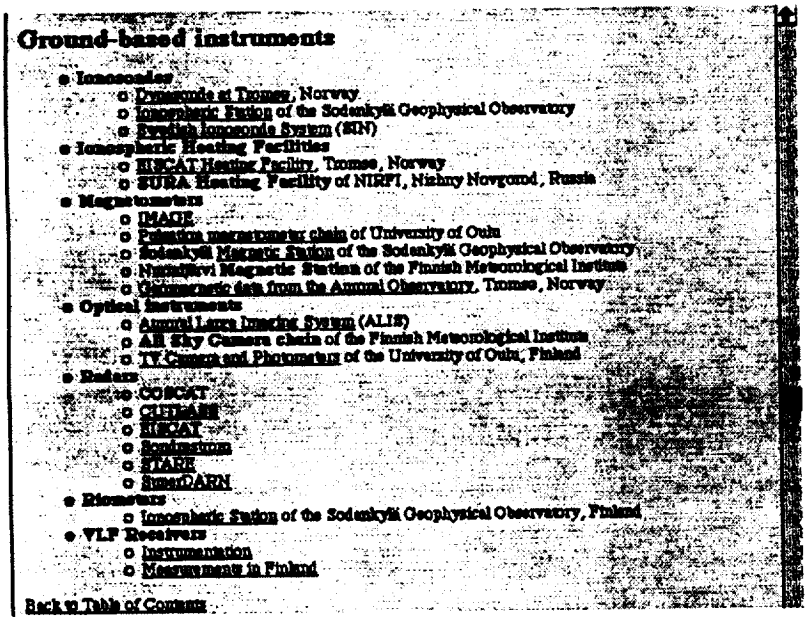
It's not possible to include specific information on every space physics related site -- this pocket guide would turn into an immense volume. There are fortunately lists of Hot Links scattered throughout the web that will lead you around the world and back as you browse. We include some of the more complete lists that we have run across in our travels. Bon Voyage!



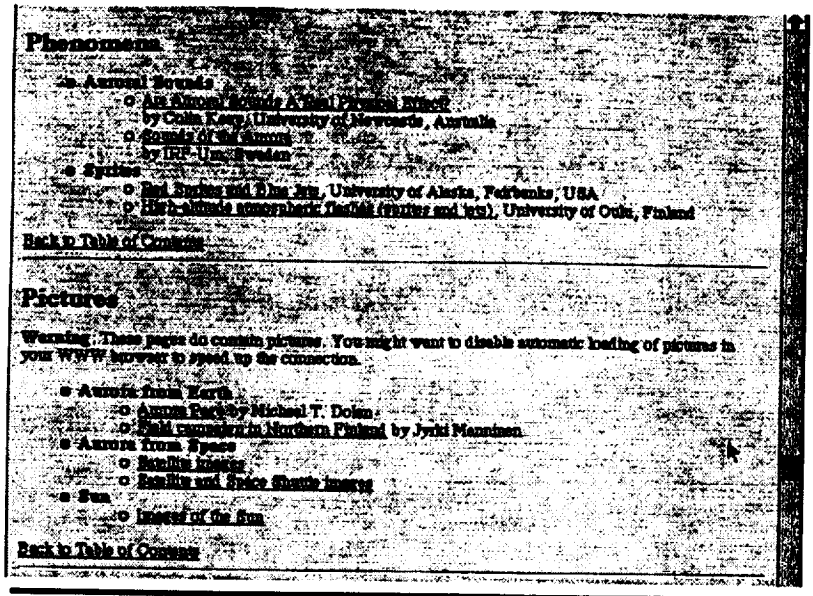


http://www.oulu.fi /~spaceweb/reference.html





http://www.oulu.fi
/~spaceweb/reference.html



Phenomena

- Auroral Sounds
  - Can Sounds Actually Be A Real Physical Effect?
    by Colin Keay (University of Newcastle, Australia
  - Sounds of the Aurora
    by IRF-Uppsala, Sweden
- Spikes
  - Red Spikes and Blue Jets, University of Alaska, Fairbanks, USA
  - High-altitude atmospheric flashes (sprites and jets), University of Oulu, Finland

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Pictures

Warning: These pages do contain pictures. You might want to disable automatic loading of pictures in your WWW browser to speed up the connection.

- Aurora from Earth
  - Aurora Page by Michael T. Dolan
  - Light reminder in Northern Finland by Jyrki Manninen
- Aurora from Space
  - Satellite images
  - Satellite and Space Shuttle images
- Sun
  - Images of the Sun

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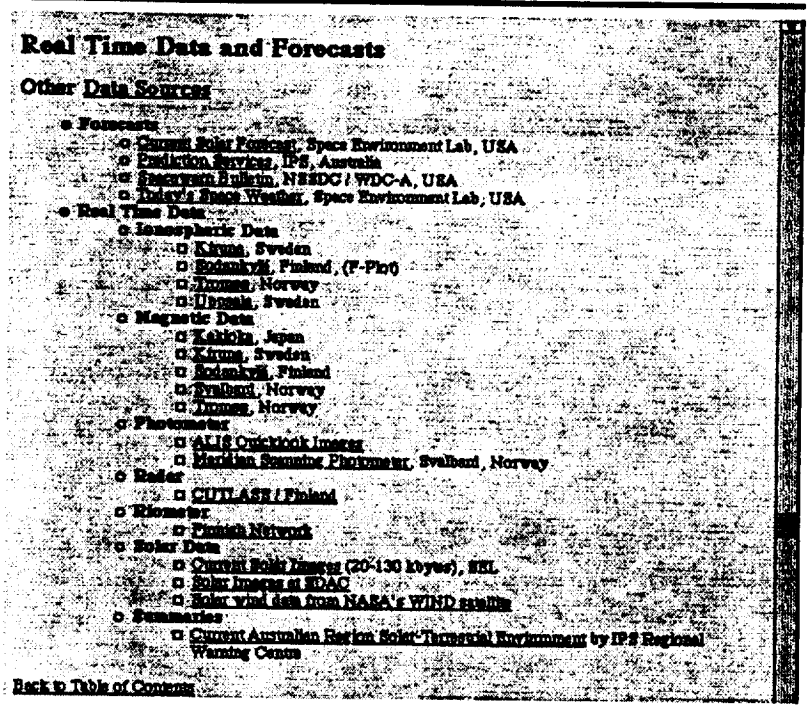

Real Time Data and Forecasts

Other Data Sources

- Forecasts
  - Current Solar Forecast, Space Environment Lab, USA
  - Prediction Services, IPS, Australia
  - Spaceguru Bulletin, NEIDC / WDC-A, USA
  - Today's Space Weather, Space Environment Lab, USA
- Real Time Data
  - Ionospheric Data
    - Kiruna, Sweden
    - Sodankylä, Finland, (F-Plot)
    - Tromsø, Norway
    - Uppsala, Sweden
  - Magnetic Data
    - Kakioka, Japan
    - Kiruna, Sweden
    - Sodankylä, Finland
    - Svalbard, Norway
    - Tromsø, Norway
  - Photometer
    - ALIS Quicklook Images
    - Meridian Scanning Photometer, Svalbard, Norway
  - Radar
    - CUTLASS / Finland
  - Riometer
    - Finnish Network
  - Solar Data
    - Current Solar Images (20-130 kbytes), SSL
    - Solar Images at SDAC
    - Solar wind data from NASA's WIND satellite
  - Summaries
    - Current Australian Region Solar-Terrestrial Environment by IPS Regional Warning Centre

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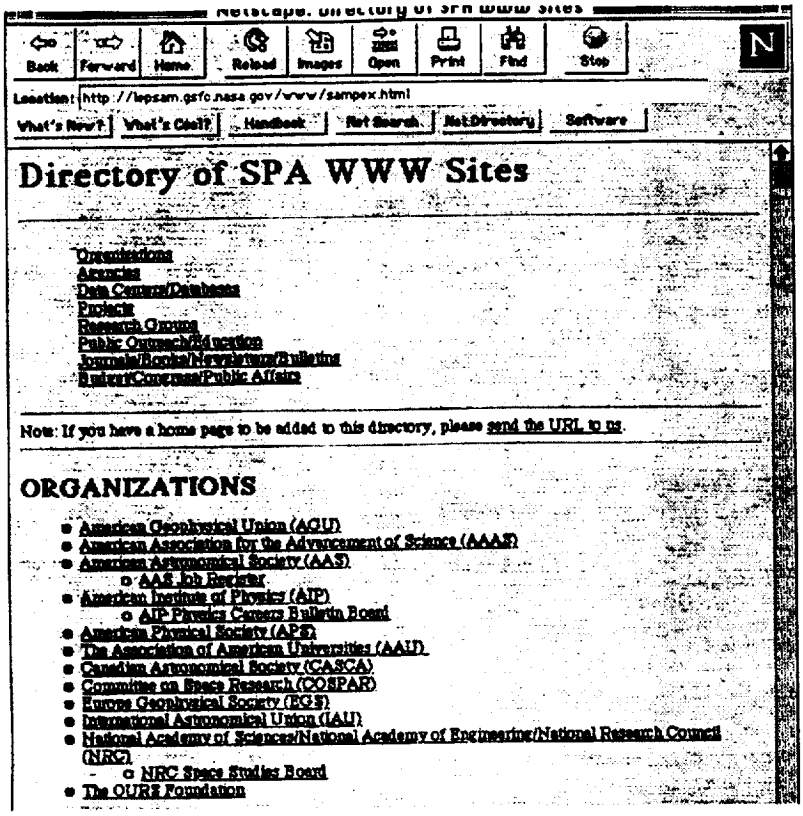
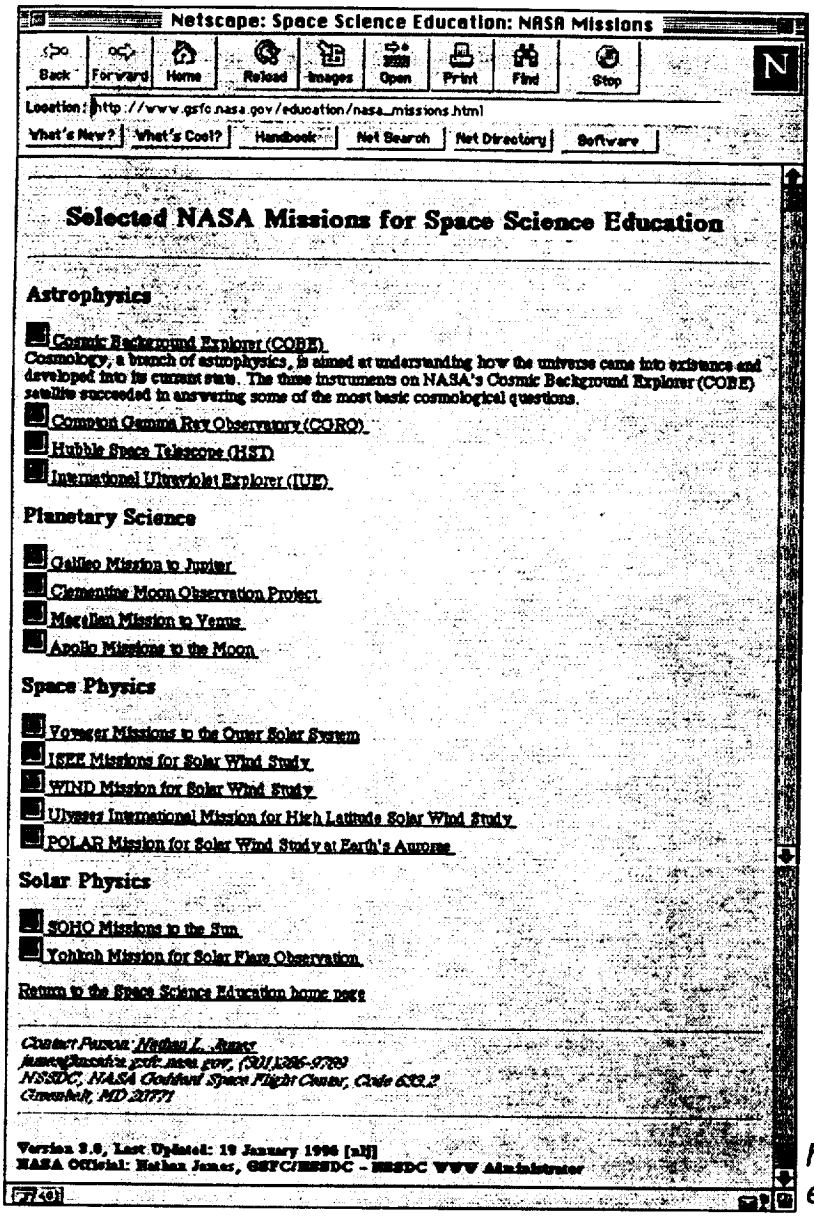
http://www.oulu.fi
/~spaceweb/reference.html

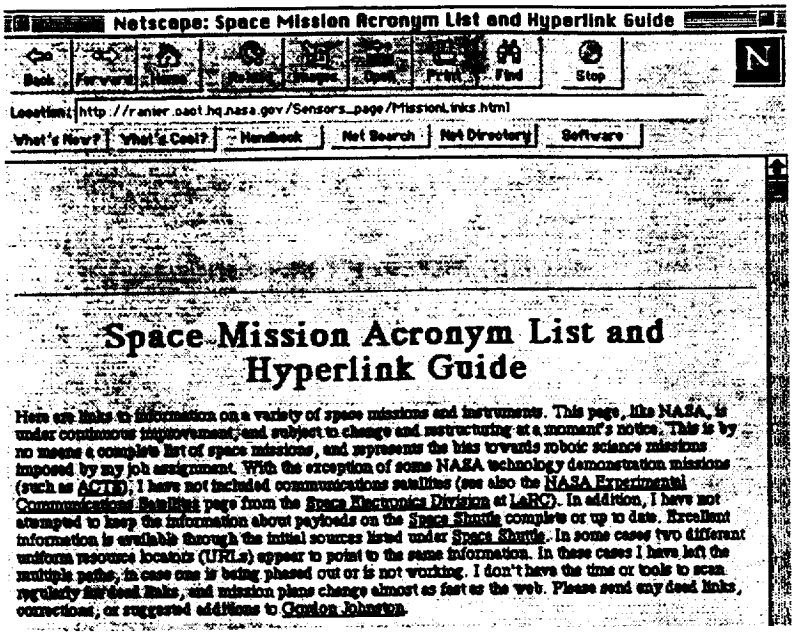


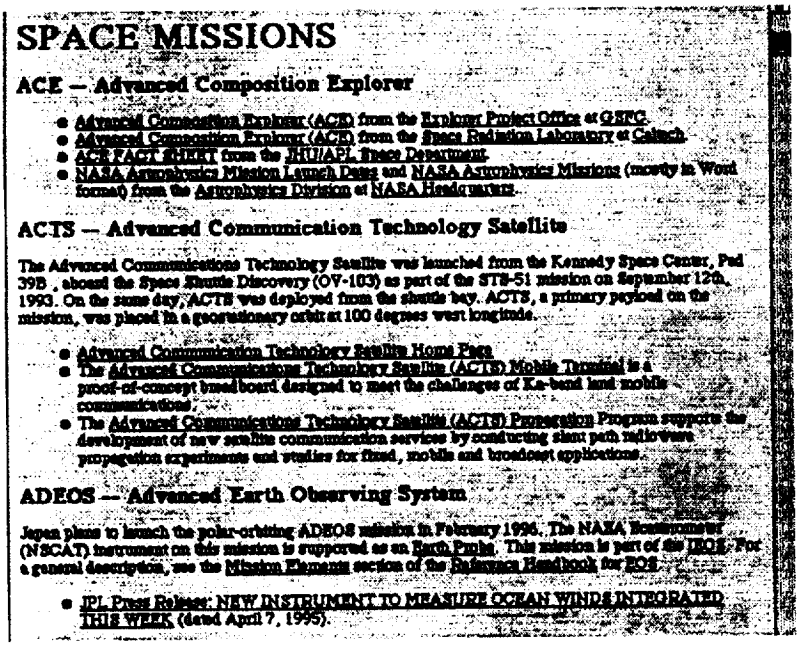
http://lepsam.gsfc.nasa.gov /www/sampex.html



A detailed look at a number of important NASA missions with Hot Links to other sources of information on the web.

http://www.gsfc.nasa.gov/education/nasa_missions.html





http://ranier.oact.hq.nasa.gov /Sensors_page/MissionLinks.html

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AGENDA

"What is Space Weather"
A workshop for science writers
February 23, 1996

8 a.m. -	Registration, continental breakfast buffet Room 2238, U-M Space Physics Research Bldg.
8:30-11:15 a.m.	Morning session Room 2238, U-M Space Physics Research Bldg.
	Welcome and Announcements: C. Robert Clauer
	"What is Space Weather and Why are we Interested: An Introduction" Daniel N. Baker Director, Laboratory for Atmospheric and Space Physics, University of Colorado-Boulder
	"Space Weather Forecasting: Who Cares?" Howard Singer Chief of Geospace Branch, NOAA Space Environment Center in Boulder, Colorado
	"Geomagnetic Storms and Threats to Electric Power Systems" John Kappenman Head of Transmission Planning Department Minnesota Power
	Informal discussion and question-and-answer period.
11:30-12:30 p.m.	Buffet lunch for all journalists and scientists with continuing discussion. 2238 Space Physics Research Bldg.
12:45 - 2:30 p.m.	Afternoon session Room 2238, U-M Space Physics Research Bldg.
	"Nowcasting to Forecasting: Getting Today's Space Weather Today" Patricia H. Reiff Professor of Space Physics and Astronomy Rice University
	"Mining Information Related to Space Weather Using the World Wide Web" Janet U. Kozyra Associate Research Scientist U-M Space Physics Research Laboratory

"Satellites, Research and Space Weather"
Mario Acuna
Goddard Senior Fellow, NASA Goddard Space Flight Center

"So What if there is a Little Spot on the Sun"
Joe Gurman
Facility Scientist for the Solar Data Analysis Facility, NASA Goddard Space Flight Center

General discussion and question-and-answer period.

3 p.m. — Colloquium Lecture
Auditorium, Francois-Xavier Bagnoud Bldg.

"How Does the Dynamic Space Environment Affect Our Technologies in Space and on the Ground."
Louis Lanzerotti
AT&T Bell Labs and University of Florida

4:30 - 6 p.m. — Laboratory research demonstration of The Upper Atmospheric Research Collaboratory (UARC), featuring coordinated ionospheric observations in Greenland, and data from the WIND satellite.
Room 2520 Space Physics Research Bldg.

C. Robert Clauer
Research Scientist
U-M Space Physics Research Laboratory

6:30 - 8 p.m. — Dinner at one of Ann Arbor's excellent restaurants for all scientists and journalists who wish to attend.

After 8 p.m. — Continuing UARC supported experimental campaign operations and opportunity for additional follow-on participation and interviews by journalists.

Committee on the Future of the U. S. Space Program, and membership on the Vice President's Space Policy Advisory Board. He has been elected to the National Academy of Engineering, and the International Academy of Astronautics and is a Fellow of the American Geophysical Union, the American Physical Society and the American Association for the Advancement of Science. He has published over 400 science and engineering papers and is co-author or co-editor of three books. Dr. Lanzerotti will present a colloquium lecture titled: "How Does the Dynamic Space Environment Affect our Technologies in Space and on the Ground"

Dr. Patricia H. Reiff received the Ph.D. from Rice University, Houston, and is now Professor of Space Physics and Astronomy there. She has been active for over 20 years in the area of solar wind-magnetosphere-ionosphere coupling. She is a Co-Investigator on the Magnetic Field Experiment on the POLAR spacecraft (to be launched January 1996), and a Co-Investigator on the PEACE electron spectrometer on the Cluster suite of spacecraft (to be launched April 1996). She is the liaison between real-time solar wind data from the WIND spacecraft and the real-time Magnetospheric Specification and Forecast Model at Rice. In addition, she is the PI of a public information program "Creating the Public Connection" which brings real-time Earth and Space data to schools in the form of interactive computerized displays (both as physical kiosks in the Houston Museum of Natural Science and as web-based information servers). This project, funded by NASA's Digital Library Technology Program, has brought space weather to over 100,000 museum visitors and over 100,000 web visitors last year. She will present "Nowcasting to Forecasting - Getting Today's Space Weather Today"

Dr. Raymond G. Roble received the Ph.D. from the University of Michigan and currently is a senior scientist at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. His research concentrates on the chemistry, physics, and dynamics of the upper atmosphere and on global atmospheric electricity. He has constructed a hierarchy of general circulation models of the coupled thermosphere-ionosphere-mesosphere system and his most recent model is called a thermosphere-ionosphere-mesosphere-electrodynamics general circulation model (TIME-GCM) that extends over the 30 to 500 km altitude range. These various general circulation models have been used to analyze data from the NASA Atmosphere Explorer, Dynamics Explorer, Solar Mesosphere Explorer, and Upper Atmosphere Research Satellite. He has served on numerous national and international committees and has authored and co-authored over 230 publications. He is a fellow of the American Geophysical Union.

Dr. Howard Singer received the Ph.D. from the University of California, Los Angeles and is presently the Chief of the Geospace Branch at the NOAA Space Environment Center in Boulder, Colorado. He is the responsible scientist for the Geostationary Operational Environmental Satellite (GOES) spacecraft magnetometers and the Lead Scientist for the GOES Space Environment Monitor instruments used for space weather operations, which includes monitoring and predictions. Prior to working for NOAA, Dr. Singer participated in the joint AF-NASA Combined Release and Radiation Effects satellite (CRRES) program used to examine the effects of space weather on spacecraft systems. Dr. Singer spent one year as a reserach scientist at South Pole Station, Antarctica, currently conducts research on geomagnetic disturbances that affect human activities in space and on the ground, has authored or co-authored over 70 publications and is a Co-investigator on the POLAR and CLUSTER satellite missions. He will present "Who Cares about Extra-terrestrial Weather?"

WORKSHOP PARTICIPANTS

"What is Space Weather?"
A workshop for science writers
February 23, 1996

Dr. Mario H. Acuna, Goddard Senior Fellow, NASA Goddard Space Flight Center. Dr. Acuna received the Ph.D. degree from The Catholic University of America in Washington, D.C. His interests have centered around experimental investigations of the magnetic fields and plasmas in the solar system. He is US Project Scientist for the International Solar Terrestrial Physics Program (ISTP), a joint international research effort by Japan, Europe and the US involving more than 1000 investigators and the launch of nine spacecraft in the early and middle 1990's. He has participated in numerous satellite experiments and missions, including the Explorers 47 and 50 missions, Mariner 10, Pioneer 11, Voyagers 1 and 2, MAGSAT, Project Firewheel (Germany, Canada, USA & UK), Viking (Sweden), The Active Magnetospheric Particle Tracer Explorers (AMPTE), (Germany, US, UK), the International Solar Polar Mission (currently ULYSSES), the GIOTTO mission (ESA) to comet Halley. He is the Principal Investigator for the Mars Observer Magnetic Field Investigation, launched in 1992 and to be followed by Mars Global Surveyor in 1996. Dr. Acuna has published over 70 refereed scientific papers and has been honored with several distinguished awards. In 1985 he was selected by the IEEE Magnetics Society as one of three Distinguished Lecturers to speak on the subject of Space Magnetometry.

Dr. Daniel N. Baker received his PhD from the University of Iowa and is currently Director of the Laboratory for Atmospheric and Space Physics at the University of Colorado at Boulder and a Professor in the University of Colorado's Department of Atmospheric, Planetary and Astrophysical Sciences Department. Dr. Baker has devoted much of his recent research effort to understanding magnetospheric substorms. He has shown how these disturbances contribute to anomalies in the operation of near-earth spacecraft and has developed nonlinear (chaos) models of substorm processes. He is the author or co-author of approximately 280 scientific papers in refereed journals in the area of space research and he presently serves on several NASA advisory committees. Dr. Baker is a member of AAAS, Sigma Xi, International Academy of Astronautics, and is a Fellow of the American Geophysical Union. He will present "What is Space Weather and Why are we Interested: An Introduction"

Dr. C. Robert Clauer received the Ph.D. from the University of California, LosAngeles and is a Research Scientist and Adjunct Professor of Atmospheric, Oceanic and Space Physics at the University of Michigan. He is a principal investigator on several projects which utilize ground based instrumentation in the arctic and Antarctic in coordination with satellite measurements to investigate the coupling of energy between the solar wind and the Earth's magnetic field and ionosphere. He is also a Co-Investigator on the POLAR Satellite mission. He is an Associate Editor of the Journal of Geophysical Research -- Space Physics and is an author on over 60 research publications.

Dr Joe Gurman received the Ph.D. from the University of Colorado, and is the Facility Scientist for the Solar Data Analysis Center at Goddard Space Flight Center in Greenbelt, Maryland. He was the Solar Maximum Mission (SMM) Project Scientist from 1986 to 1989, and the Instrument Manager for the Ultraviolet Spectrometer and Polarimeter (UVSP) on SMM from 1985-1989. He is currently a Co-Investigator on the Extreme ultraviolet Imaging Telescope (EIT) on the SOHO satellite. His research concentrates on sunspots and the sun's outer atmosphere. He will present "So what if there is a Little Spot on the Sun."

Mr. John Kappenman received the Electrical Engineering degree from South Dakota State University and is presently Head of the Transmission Planning Department at Minnesota Power. He is undertaking research on magnetic storms and their disruptive effects on electrical power systems and is leading a design team to develop mitigation techniques. He is a senior member of the Institute of Electrical and Electronics Engineers and the Power Engineering Society and is the chair of the Transmission and Distribution Committee. He is Chair of the Industry Advisory Board for the University of Minnesota - Duluth Electrical and Computer Engineering Department. He holds a US Patent for his invention of a Static Phase Shifting Transformer. He has over 30 publications on the subjects of geomagnetic disturbances, power electronics, and the analysis of lightning impacts on electric power systems.

Dr. Timothy L. Killeen received his Ph. D. from the University College, London and is presently Professor of Atmospheric and Space Sciences at the The University of Michigan. Major area of interests in physics and chemistry of the Earth's Upper Atmosphere. He is the Director of the Space Physics Research Laboratory, The University of Michigan, and is an associate editor for the Journal of Atmospheric and Terrestrial Physics. Dr. Killeen has authored and co-authored over 120 publications in refereed journals.

Dr. Janet U. Kozyra received her PhD from the University of Michigan and is currently an Associate Research Scientist at U of M's Space Physics Research Laboratory within the Department of Atmospheric, Oceanic and Space Sciences. She has participated in a number of NASA science missions, first as an Interdisciplinary Scientist on the Dynamics Explorer satellite team, as a guest investigator on the Anomalous Magnetospheric Particle Tracer Experiment/ Charge Composition Explorer (AMPTE/CCE) science team and as been recently selected as an interdisciplinary scientist for the Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) spacecraft mission which is currently in the development phase. She is actively involved in developing content for a earth and space sciences information site on the world wide web called "Windows to the Universe" which provides a linkage to NASA's space databases and is supported by NASA's Office of High Performance Communications and Computing. She is an associate editor of Geophysical Research Letters and a member of the National Academy's Committee on Solar and Space Physics (CSSP). She was a recipient of the 1992 University of Michigan Outstanding Research Scientist Award. She will present "Mining Information Related to Space Weather Using the World Wide Web"

Dr. Louis Lanzerotti received the Ph.D. degree from Harvard and is a Distinguished Member of Technical Staff at AT&T Bell Laboratories, and Adjunct Professor of Electrical Engineering at the University of Florida. He has also served as Regents' Lecturer at UCLA. His principal research interests include space plasmas, geophysics, and engineering problems related to the impact of space processes on space and terrestrial technologies. He has participated on or chaired numerous national and international science and science policy committees, including two terms as chairman of the Space Studies Board of the National Research Council, a member of the 1990 Vice-Presidential Advisory